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# SUMMARY OF RESEARCH

ACADEMIC DEPARTMENTS

1987 - 1988



OFFICE OF THE ACADEMIC DEAN  
UNITED STATES NAVAL ACADEMY  
ANNAPOLES, MARYLAND

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**SUMMARY**  
**OF**  
**RESEARCH**

1987-1988

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COMPILED AND EDITED  
BY  
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ENGLISH DEPARTMENT

DECEMBER 1988

UNITED STATES NAVAL ACADEMY  
ANNAPOLIS, MARYLAND

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# Foreword

The role of research at the Naval Academy is to maintain an atmosphere of scholarly excellence in which midshipmen seek knowledge. Discipline and curiosity are both essential to a naval officer, as to any educated man or woman, and the balance of these traits determines the character of our graduates.

In the nearly two decades since the Research Office was created, progress can be measured by the growth in research budgets, papers, books, and presentations. Naval Academy faculty and midshipmen have seized the opportunities to do research provided by local and nearby facilities, research courses, sabbaticals, and travel support.

The information presented in this report describes the research projects and productivity of our faculty and midshipmen for the 1987-1988 academic year. Each of sixteen academic departments in five divisions presents the details of its efforts. The history of the budget and productivity is presented in Figures 1 and 2, showing the growth of research by our faculty.

This growth parallels the increase in civilian faculty Ph.D.s to ninety-one percent and growth of

the programs of research chairs, which has recently remained steady at six. These chairs are sponsored by various Naval Systems Commands, Naval Operations and the Chief of Naval Research. Our research funding is distributed over basic research, exploratory and advanced development, as well as O&M,N funds which contributed to the recent increase in support for newer faculty, and are administered by our Naval Academy Research Council. Additional operating funds were devoted to supporting thirty-four faculty members' efforts in instructional development, largely devoted to exploiting the Zenith 248 computers newly acquired by our faculty and midshipmen. Our major reimbursable sponsor, after the Chief of Naval Research, continues to be the David Taylor Research Center, whose Annapolis and Carderock Laboratories supported the work of twenty-two of our faculty for a total of \$282,000. The Naval Research Laboratory funded sixteen faculty members' research this year, under our Cooperative Program, for a total of \$241,000.

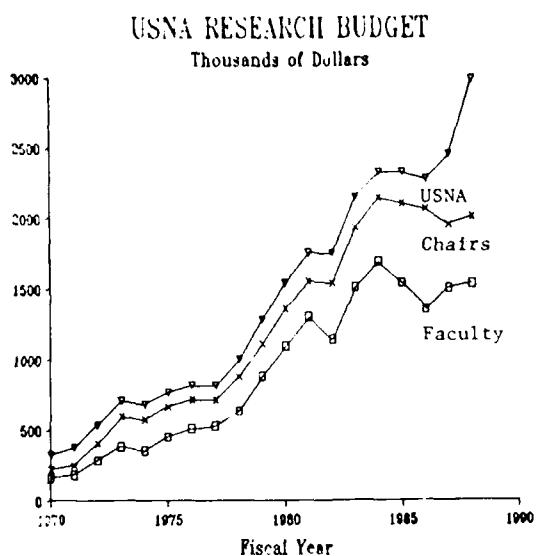


Figure 1. The growth of the research budget since 1970 reflects contributions from Academy-wide programs such as the Naval Academy Research Council and the Instructional Development Program, from academic Department-managed research Memoranda of Understanding and from sponsored projects of individual faculty.

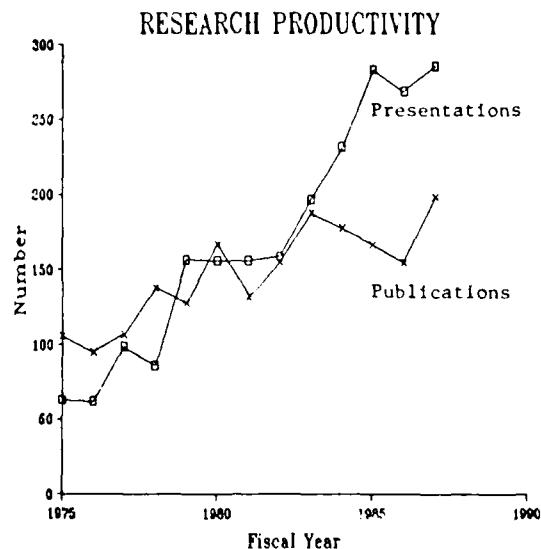


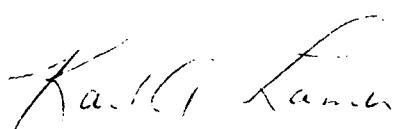
Figure 2. The productivity of faculty and midshipmen, measured through publications and presentations, has increased with the research budget.

## FOREWORD

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Midshipmen participation in research at the Naval Academy continues with ninety-eight research courses reported, seven Trident Scholars (with eight selected for the coming year) and nearly one hundred midshipmen using summer leave time to work with a dozen Navy, DoD, and Federal Laboratories.

Further collaboration was developed with new Memoranda of Understanding between the Naval Academy and the National Security Agency, Colorado State University, the Naval Space Command, the Naval Facilities Engineering Command, and the Naval Sea Systems Command.



KARL A. LAMB  
Academic Dean

In addition to research chair holders, the Naval Academy hosted visiting faculty from the Naval Surface Warfare Center and the Naval Coastal Systems Center under the Naval Scientist Training and Exchange Program (NSTEP), from the Royal Naval College, from the David Taylor Research Center, and from various other institutions under the National Faculty Exchange Program and the Intergovernmental Personnel Act. This active visiting professor program, along with our sabbatical and travel programs, keeps the Naval Academy in the mainstream of naval and academic research activity.



CARL S. SCHNEIDER  
Director of Research

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Division of  
Engineering and Weapons





# Aerospace Engineering

Commander Vernon C. Gordon, USN  
Chairman

The research summary for the Aerospace Engineering Department reveals a deep interest by the faculty in a diverse range of subjects. This intense research effort provides a dynamic learning environment. It keeps the faculty up-to-date in their respective fields and enhances the classroom learning experience of the student by keeping the classroom material up-to-date as well.

Midshipmen have been actively involved in research efforts in the department. Through the Trident Scholar program, and the various research and design courses, midshipmen have been challenged to do independent, creative thinking and logical problem solving. The guidance of experienced faculty members has been the key element in this learning experience.

Work continued in numerous areas of sponsored research, including flow measurement studies, small propeller efficiency studies, ship hull design, structural design using the Finite Element Method, and the use of computational fluid dynamic codes in helicopter rotor dynamics.

The Naval Space Command sponsored Satellite Tracking Facility is well under way. The antenna pad has been poured. The antenna is ready for assembly and the integration contract to install the system is in place. This facility opens a whole new avenue of space-based research opportunity for students and faculty alike.

This year, in addition to the normal department research activity, four local area highschool students were sponsored under the Naval Academy Mentorship program. This allowed the students to work in the areas of computer graphics, aerodynamics, helicopter aerodynamics, and flight mechanics. Next year six students will participate in the program.



This has been an active and challenging year for research in the Aerospace Engineering Department. The future appears even brighter as the faculty expands its numbers, deepens its research interests, and extends its teaching expertise.

## Sponsored Research

### Flow Distribution in the Exhaust System of the ICR Engine

Researcher: Associate Professor John E. Allen

Sponsor: David Taylor Research Center, Annapolis Laboratory

A long-term experimental program is being conducted which includes the construction of a Navy-owned and -operated scale model test facility. Cold air flow tests over the operating range of proposed intercooled regenerative (ICR) engine exhaust flows will result in flow field maps from 5-hole probe, hot wire anemometer, and laser

doppler velocimeter measurements. The complex 3-D flow will be modeled with existing computational codes and validated with test data. The result will be a model to predict full-scale flow distribution with temperature effects for use in design of the next generation marine gas turbine engines.

### Astronautics Curriculum Development

Researcher: Visiting Professor Harold D. Black

Sponsor: Naval Space Command

The purpose of this research was to develop new courses in support of the expansion of the Aerospace Engineering major to include courses in the area of astronautics. The particular area of interest was astrodynamics, with the primary goal of developing a completely new course, EA462, Astrodynamics II. This course was developed and imple-

mented to teach the numerical techniques required in orbit determination, satellite geodesy, and orbital perturbation techniques. A set of detailed text material was developed. During this year the text was revised and modified for more effective teaching.



## Low Speed Aerodynamics

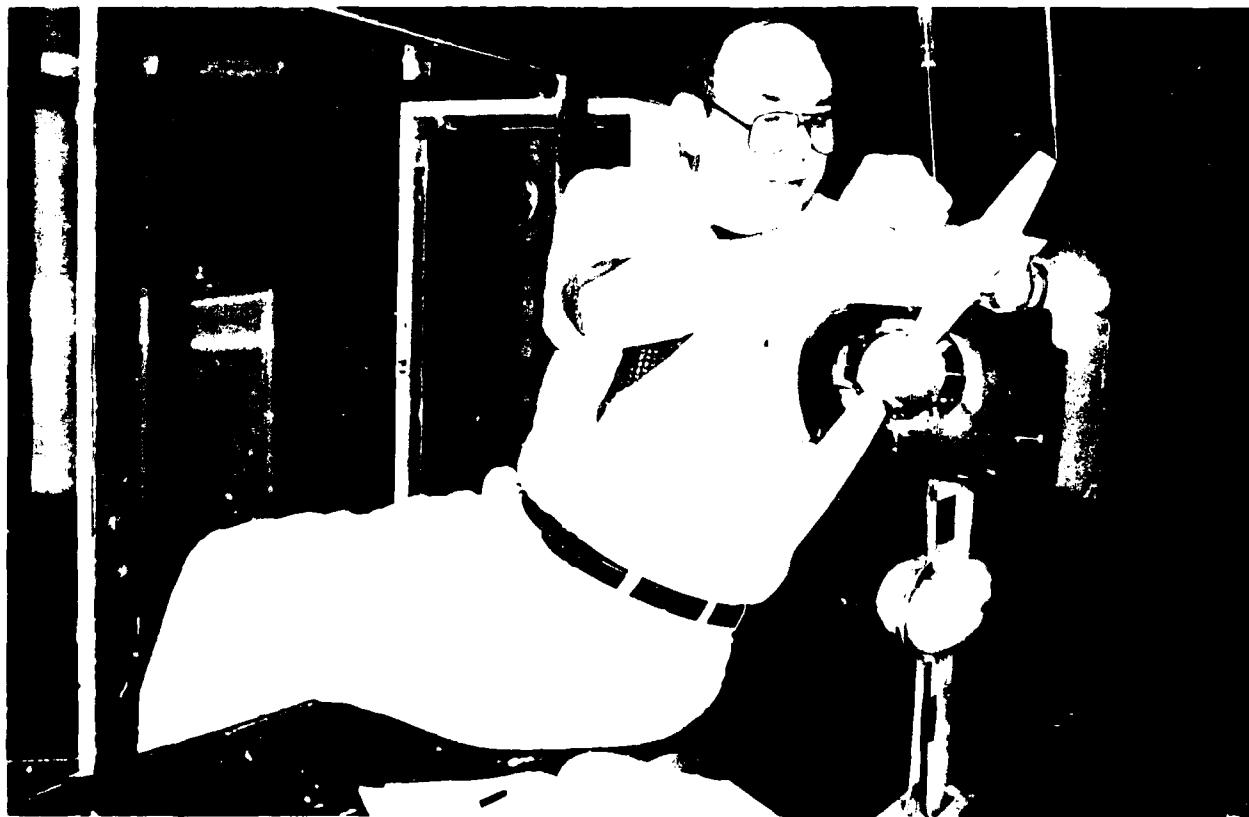
Researcher: Professor Bernard H. Carson  
Sponsor: Naval Research Laboratory

Presently, the Navy is developing a new generation of unmanned aircraft designed to fulfill operational requirements that cannot be met by current remotely-piloted vehicles (RPV's). The most stringent design requirement for these aircraft is the ability to fly at typical surface ship speeds, speeds far lower than other RPV's have been designed for or are able to demonstrate. Only slightly less challenging is the requirement that these aircraft have long loitering, or station-keeping capability up to ten or more hours.

The development of such aircraft has been hampered by a dearth of technical knowledge in this flight regime, since the bulk of existing aeronautical research has traditionally been directed towards full-scale aircraft applications where flight takes place at much higher airspeeds than is anticipated in the present application. Thus, the Naval Research Laboratory has undertaken a comprehensive program directed towards a better understanding of "low speed aerodynamics" and other factors affecting the efficiency of flight at very low airspeeds.

The current investigation consisted primarily of wind tunnel studies in the USNA Aerospace laboratories on typical propeller designs that will be employed in flight test vehicles presently under development. These studies are crucial to the program, since the findings will permit the design of more efficient propellers, and because the findings will be needed to evaluate the flight test data generated by the test vehicles.

The investigator installed a complete vehicle afterbody of the test vehicle (which contains the vehicle's powerplant, engine controls, and cooling system) in the wind tunnel and evaluated this unit under simulated flight conditions. In addition to establishing the overall effectiveness of the propulsion unit, the researcher determined the propeller characteristics, and the propulsive efficiency of the design. This effort has thus far revealed a number of unanticipated deficiencies in the basic design, which, if left uncorrected, would have led to costly delays and failures in the vehicle's flight test phase.



## Prevention of Free-edge Delaminations by Structural Tailoring

Researcher: Assistant Professor Walter K. Daniel  
Sponsor: Naval Academy Research Council (ONR)

Composite materials offer increased structural performance at the cost of increased complexity of analysis and new failure modes. Certain failure mechanisms such as free-edge delaminations do not apply to conventional metallic materials. As more advanced materials are used in Navy aircraft, the new failure mechanisms become a major cause for concern.

The researcher is investigating techniques to suppress free-edge delaminations. Initial theoretical work is being conducted to determine the best arrangements of plies for different structures. A number of complex finite element models will be constructed to verify theoretical work and to extend

the analysis to full-scale aircraft structures. Numerous test coupons will be fabricated using the University of Maryland at College Park autoclave that was funded in part by the Office of Naval Research. The experiments will be used to validate the theoretical and finite element work.

There is significant interest in this line of research. Bell Helicopter recently announced results for a similar--though less effective--tailoring scheme. The long-term goal for this research is to fabricate a full-scale bearingless rotor hub using structural tailoring and then test the article under realistic conditions, using the rotor facility located in the Aerospace Engineering Department laboratories.

## Turbomachinery Design

Researcher: Associate Professor Gerald F. Hall  
Sponsor: David Taylor Research Center, Annapolis Laboratory

An ongoing problem in the design of turbomachinery for underwater applications is noise. It is obvious, from a military standpoint, that any underwater vehicle that radiates large amounts of acoustic energy (i.e., is noisy) is easily detected and has its military mission severely compromised.

Turbomachines are a major contributor to the overall noise problem. They are comprised of rotating and stationary parts in a water and/or air environment. These surfaces interacting through the fluid medium give rise to fluctuating pressure fields that are the principal source of noise. In order to predict the pressure fields with sufficient accuracy to determine the acoustic properties, an extremely accurate solution to the pressure field must be

obtained, and this accuracy must be maintained over a wide range of operating conditions to cover off-design conditions. As an example, one hundred or more harmonics of the pressure field may be needed to obtain an acceptable acoustic signature of a machine.

David Taylor Research Center is currently evaluating computational fluid dynamical methods to incorporate into their design process that will provide this necessary accuracy in the unsteady pressure determination. These methods include Navier-Stokes solvers and panel methods. The effort consists of selecting, evaluating, and recommending the appropriate techniques.

## Bending-Torsion Flutter of High-Aspect Ratio Wing with Static Elastic Coupling

Researcher: Assistant Professor Gabriel Karpouzian  
Sponsor: Naval Academy Research Council (ONR)

This project is in the area of aeroelasticity, which is concerned with high-aspect-ratio wing flutter, allowing static elastic coupling between bending and torsion for wing structures made of composite materials. This study shall facilitate the design-concept development for aircraft flutter analysis, in that a simple and versatile analytical method based on an asymptotic theory will be developed. The work will constitute an extension of a development made in a recent study on high-aspect-ratio wing flutter of homogeneous isotropic material. The research will involve evaluation of the bending and torsion stiffness coefficients, and the elastic coupling

coefficient for several generic examples from basic data for composite materials. Comparisons of the theoretical and numerical solutions of the wing flutter problem will be presented in order to ascertain the adequacy of the theory.

This work is still in progress. The asymptotic theory has been applied for different orders of magnitude of the elastic coupling coefficient. The analysis is being carried out to determine the flutter solutions for each case. Ultimately, the results obtained have to be ascertained by other means such as numerical solutions and/or existing data for comparison and lending support to the theory.

## Hull-Superstructure Interaction

Researcher: Assistant Professor Michael D. A. Mackney  
Sponsor: Naval Academy Research Council (ONR)

This research in the area of ship structural design is concerned with studying the behavior of the ship's hull and its interaction with the superstructure. This complex, three-dimensional, non-linear elastic phenomenon is of considerable interest to ship designers seeking to improve the structural integrity and performance of vessels operating in variable environmental conditions.

In order to improve the stability, radar cross section, and general structural performance of warships in particular, composite and sandwich materials, having low modulus and non-linear characteristics, are being considered. Since these materials can be designed to incorporate stiffness and strength in specific directions, a knowledge of the load transmission and diffusion paths in the hull and superstructure is required for a variety of geometries.

The researcher is comparing simplified hull-superstructure models using a two purpose written preprocessor and the GIFTs finite element pro-

gram, evolving the parametric investigation. The sensitivity analysis of the parameters under review will require the design and writing of a post-processor to GIFTs.

Since a complete understanding of the hull-superstructure phenomenon cannot be made entirely from numerical studies, work is continuing in defining the experimental program. Following the detailed parametric studies, a revised 'likely configuration' model is being designed from which the study may be concluded.

The second preprocessor has been developed and implemented on a personal computer in True BASIC. It is being further developed for implementation on a high end engineering workstation, on which the finite element processor is being implemented.

The research is continuing along the planned directions, but with some delays in setting-up the new workstation, and in implementing the system and processing software.

## Introduction to Space and Design of Spacecraft

Researchers: Visiting Professor George F. Pieper,  
Professor Robert A. Granger, and Assistant Professor Kenneth F.  
Read (Mechanical Engineering Department)  
Sponsor: Naval Space Command/Naval Supply Systems Command

The investigators developed a textbook in support of Naval Space Command ongoing efforts to upgrade the level of spacecraft engineering knowledge within the fleet. The book includes sections on space envi-

ronment, orbital mechanics, space operations, the acquisition system, spacecraft design, and spacecraft applications.

## Computer-Aided Hull Design and Model System

Researcher: Professor David F. Rogers  
Sponsor: United States Coast Guard

The researcher continued a multi-year investigation into the area of a computer-aided design system for ship hulls and towing tank models. The thrust of the research is to improve ship hull fairing techniques

and data manipulation routines. These improvements will then be integrated with current Coast Guard design analysis to provide a improved ship design system.

## Prediction of Helicopter Free Flight Trim Using a State of the Art Analytical Model

Researcher: Midshipman 1/C Glenn W. Pendrick, USN  
Adviser: Associate Professor Gerald F. Hall  
Sponsor: Trident Scholar Program

To aid in the design and analysis of rotors, a reliable and efficient code of aircraft aerodynamics is required. With such a code, expensive flight test time may be optimized. A reliable code also allows the engineer to determine the relationship between full scale wind tunnel tests and free flight. In this report, the research code CAMRAD, Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics, is investigated to determine if it can be relied upon to construct a free flight test matrix for the prototype Boeing Vertol Helicopter Model 360.

Excellent correlation was found between CAMRAD's wind tunnel analysis and testing data on the Model 360 in the Duits-Nederlandse Windtunnel (DNW) for forward flight conditions. CAMRAD was unable to simulate properly partial power descent conditions from the DNW. The free flight analysis on CAMRAD compared well to theoretical helicopter aerodynamics. A free flight test matrix was constructed from the CAMRAD simulation.

# Independent Research

## Weight Reduction of Suspension Components Using Hollow Bar Stock

Researcher: Professor William J. Bagaria

Research using hollow bar stock instead of solid bar stock for vehicle suspension components as a weight reduction, performance improvement method continues. Suspension components are primarily under torsional loads, thus hollow stock could be used to carry these loads at a significant savings in material

weight. The stress equations have been developed and hardware designed for the investigation. Fabrication of test fixtures is complete. Experimental verification of the theoretical equations remains to be completed.

## Naval Academy Rotor Test Facility Flow Model Study

Researcher: Associate Professor Gerald F. Hall

The rotor test facility at the Naval Academy has produced data anomalies during rotor testing. The cause of these anomalies is unclear. A scale model of the rotor test facility with transparent sides is being constructed to investigate this problem. The model test chamber will allow visualization and

more detailed investigation of the complex flow field within the rotor test facility. Upon completion of the scale model testing, the rotor facility will be modified to improve the flow field in the actual test section.

# Research Course Projects

## Catalog of Boundary Control Experiments Conducted at the USNA by Sir Frank Whittle

Researcher: Midshipman 1/C James L. Johnson, USN  
Adviser: Lieutenant Commander David Adcock, RN

Sir Frank Whittle produced eight distinct new wing sections in his boundary layer experiments at the United States Naval Academy. Wings utilizing rollers in order to produce the magnus effect were able to produce lift coefficients of 1.28 while completely eliminating wake drag. The later series of testing investigated boundary layer blowing as an alternative method of preventing separation and

increasing circulation. CL values of 4.4 were achieved, along with lift/wake drag ratios of 140. Some of the numerical data need to be refined due to experimental difficulties. The pertinent results of this work are reported to establish the configuration offering the most potential for future development. On the basis of this study, recommendations for future work are proposed.

## Effects of Using A Rotating Cylinder for Boundary Layer Control

Researcher: Midshipman 1/C James L. Johnson, USN  
Adviser: Lieutenant Commander David Adcock, RN

Earlier work at the Naval Academy had indicated the potential of producing high lift at low speed by incorporating a rotating cylinder into a wing section. Following up on this work, the researcher designed a model, and then constructed and tested it in USNA's 54" x 38" low speed wind tunnel. Balance measurements and wake momentum defect measurements were made to determine the two-dimensional characteristics of the wing section. The

model's design was based on the NACA 64-415 section to provide a basis for comparison with a conventional wing section. Tests were conducted at a Reynolds number of 150,000, varying the trailing edge geometry, angle of attack, and roller speed. Lift-to-drag ratios of over 80 were attained. Other characteristics of the circulation control model are reported.

## An Expert System Satellite Management (SATMAN) Program

Researcher: Midshipman 1/C Daniel W. Mulligan, USN  
Adviser: Visiting Professor Harold D. Black

In cooperation with the Applied Physics Laboratory (APL) of the Johns Hopkins University (Dr. Andrew Goldsinger of the Space Department), studies into the implementation of an expert system to assist in the management of U.S. Navy navigational satellites were conducted. The intent is to support the Satellite Manager, who is singularly responsible for the on-orbit management of the satellite, with an on-line expert system. The basic

architecture of the system has been developed. This system will "evolve" into an operational system as levels of "expertness" can be cataloged and implemented. The knowledge base of the system will be acquired by recording actual actions of Satellite Managers during on-orbit control. These actions will be translated to knowledge-based rules and implemented in the program.

# Design Course Projects

Each Astronautics track major in the Aerospace Engineering Department participated in a detailed spacecraft design project that was reviewed by members of the technical staff at the Applied Physics Laboratory, the NASA Goddard Space Flight Center, and by personnel from the Naval Space Command. The students completed a detailed

design of a space vehicle for specified missions. The design included spacecraft systems, orbiter interface, trajectory requirements, and data acquisition system specification. Overall supervision for the course was provided by Visiting Professor George F. Pieper, Dr. Stephen Paddock (NASA), and Mr. Fred F. Mobley (APL).

## Unmanned Interstellar Probe

Midshipmen 1/C Keith A. Beals, Martin R. Beaulieu, Frank J. Dembia, Joseph P. Kerstiens, Daniel L. Kramer, Jeffrey R. West, and James A. Zito, USN

## Supernova Watch Satellite

Midshipmen 1/C Bryant D. Allam, William J. Blackstone, Frank E. Mays, and Robert J. McKenney, Jr., USN

## Earth Pointwatcher

Midshipmen 1/C Daniel L. Begeman, Barry W. Crosby, Jr., and Darren M. Olson, USN

## Infrared Observatory

Midshipmen 1/C Robert J. Bello, Eric J. Gresia, and Douglas R. Schueler, USN

## Solar Observer

Midshipmen 1/C William M. Gross, Jon S. Hooper, Richard A. Kondo, and Richard P. Silva, USN

## Laser Relay Experiment Satellite

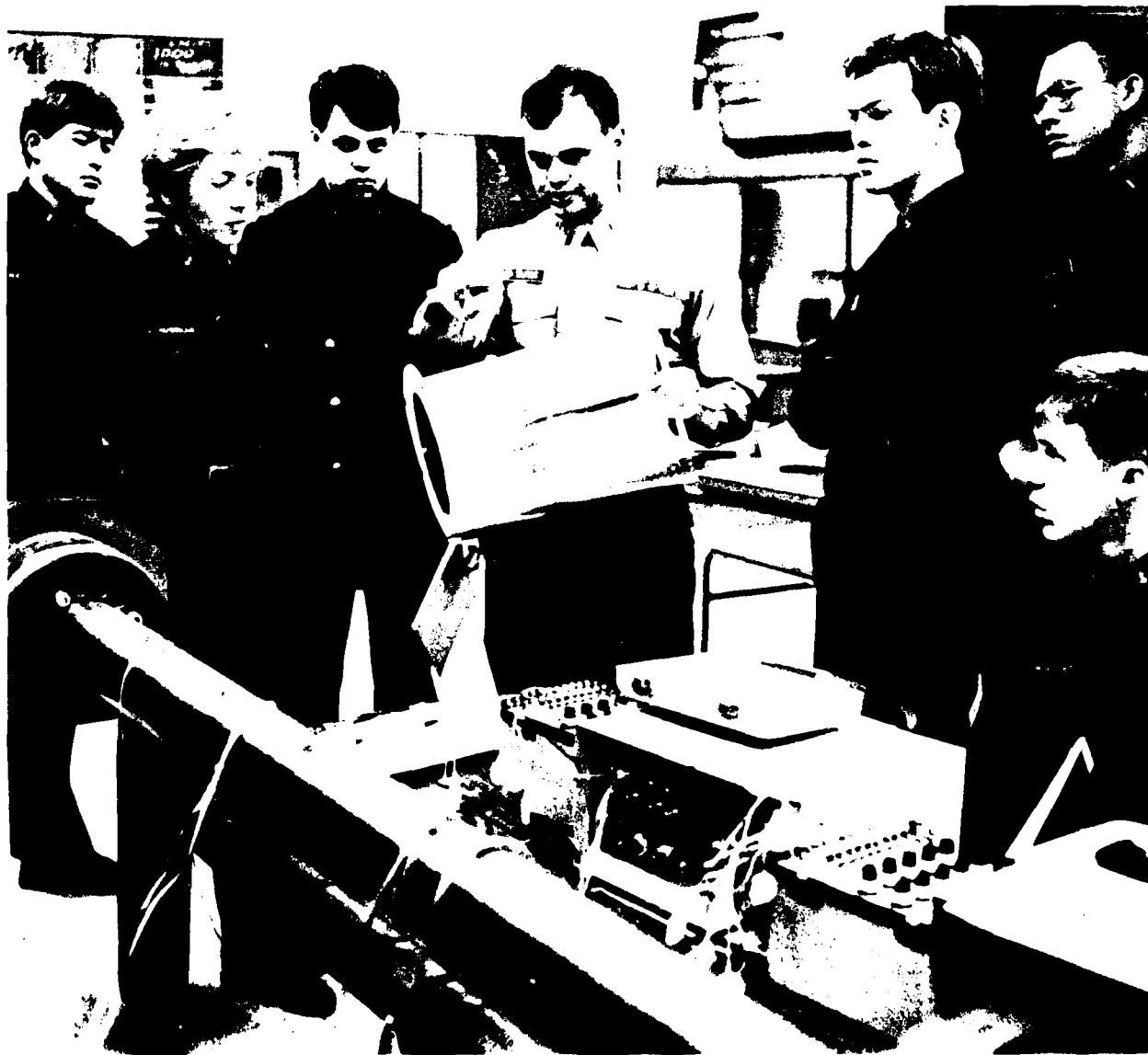
Midshipmen 1/C Roger G. Isom, Christian J. Nordlie, and Steven E. Pontell, USN

**Antenna Array Satellite Using Rigid  
Inflatable Structure**

Midshipmen 1/C Keith R. Kans, Kurt F. Miller,  
and Daniel W. Mulligan, USN

**AIAA Independent Airplant Design Competition  
The Grallae, A Drug Enforcement Interceptor Aircraft**

Researcher: Midshipman 1/C Paul M. D'Alessandro, USN  
Adviser: Commander Vernon C. Gordon, USN



## Publications

PIEPER, George F., Professor, co-author, *An Introduction to Space and Design of Spacecraft*. Annapolis, U.S. Naval Academy, Department of Mechanical Engineering, 1987.

The writing of this book was supported by the Naval Space Command. Its chapters include:

Introduction, Space Environment, Orbital Mechanics, Background of Space Exploration and Operations, Space Organizations, Navy Space Systems Acquisition Process, Operational Spacecraft Systems, Spacecraft Systems and Design Theory, Space Support to Warfighting, Applications, and Future Systems.

MACKNEY, Michael D. A., Assistant Professor, "HULGEN 2 - An Improved GIFTS Preprocessor for Hull-Superstructure Interaction Studies," Division of Engineering and Weapons Report EW-12-87, October 1987.

This report describes the improvements made to the original, simplified hull-superstructure model in order to study hull-superstructure interaction.

Improvements to the model include additional hull and superstructure bulkheads and an intermediate deck in both parts. These modest structural changes and other desired improvements resulted in a completely new preprocessor being written in True BASIC and implemented on a personal computer. Improved user interaction has resulted in more material and thickness variations being incorporated in the model, but with no changes being made to the variety of geometrical arrangements possible with the single superstructure. Such improvements allow more control to be exercised in the finite element idealization, and hence in the numerical model. As a secondary benefit, complete grids can be treated as damaged structure by suitable adjustment of material properties.

The improved model has resulted in an increase in the number of key points, straight lines, and grids which are used to describe the simplified model.

Validation of the improved model and preprocessor against the original is continuing.

## Presentations

ADCOCK, David, Lieutenant Commander, RN, "Undergraduate Education and Training of Officers in the Royal Navy," Inter-University Seminar, Chicago, Illinois, 9 October 1987.

BAGARIA, William J., Professor, "Spacecraft Design at the USNA," NASA/USRA Winter Review Meeting, Houston, Texas, 19 January 1988.

BAGARIA, William J., Professor, and Vernon C. GORDON, Commander, USN, "The Astronautics Track at the USNA," Naval Space Command Annual Review Meeting, USNA, Annapolis, Maryland, 4 May 1988.

HUBERT, Beth E., Lieutenant Commander, USN, "Opportunities and Roadblocks - A Sitrep on Women in Military Aviation," Zonta International Annual Awards Dinner, Washington, DC, 15 January 1988.

HUBERT, Beth E., Lieutenant Commander, USN, "Naval Aviation, One Woman's Perspective," Experimental Aircraft Association Fly-in, Lakeland, Florida, 11 April 1988.

JOHNSON, James L., Midshipman 1/C, USN, "The Effects of Using a Rotating Cylinder for Boundary Layer Control," AIAA Mid-Atlantic Regional Student Conference, NASA Langley, Hampton, Virginia, 15 April 1988.

PIEPER, George F., Visiting Professor, "The USNA Satellite Earth Station Facility," AIAA/DARPA Meeting on Lightweight Satellite Systems, Monterey, California, 5 August 1987.

RAPERT, Ray M., Captain, USMC, "A Heat Transfer Model for a Hot Helium Airship," AIAA Lighter Than Air Technology Conference, Monterey, California, 16-19 August 1987.



# Electrical Engineering

Lieutenant Colonel George D. Peterson, USAF  
Chairman

Electrical Engineering is a broad and rapidly developing discipline requiring our students to master not only a multitude of fundamentals but also to develop the desire and the ability to remain abreast of growth in the field. Research is fundamental to the growth of knowledge and a primary means of staying abreast of progress. Research keeps the faculty actively involved in the growth of our discipline and results in a direct contribution to the quality of the electrical engineering education that they provide to midshipmen. A related benefit is the opportunity for some midshipmen to participate in faculty guided research.

The past year has seen accomplishment in pedagogical studies as well as applied research. The results are described on the following pages. While some of the work was performed independently, the majority was supported by sponsors whose projects were in areas which directly support naval applications. Research was sponsored by the Naval Academy Research Council, the Naval Research Laboratory, the Marine Corps Research, Acquisition and Development Center, and the Naval Academy Instructional Development Program.



# Sponsored Research

## Wire Antennas for Tactical Communications

Researcher: Captain Warren P. Averill, USMC

Sponsor: Naval Academy Research Council (ONR)

The vast majority of Marine Corps communications between distant commands is via satellite. In times of crisis, long-range communications become the lifelines of support for forces on far away shores. In the President's 1984 (23 March) speech, he reminded the nation that the battlefield will soon extend into space. In such a scenario, communications satellites may very well be among the first casualties. The Marine Corps is presently ill-prepared to use the alternative means of communicating: high frequency (HF) communication (3-30 megahertz). Few communicators possess the knowledge and expertise required to set-up and maintain reliable HF links.

The objective of this project is to develop a propagation analysis and antenna design program

which can be used as a tool by tactical communicators. This research is combining the products of two agencies; an extensive antenna study conducted at Lawrence Livermore National Laboratory and a propagation analysis program written at Naval Ocean Systems Center (NOSC). With this new program the communicator will have a tool which requires a minimum of information input and a minimum of decisions. The output will be simply-stated instructions on how to set up the antenna and guidance on the proper use of the frequencies available. This project was a collaborative effort with the Marine Corps Development Center, Quantico, Virginia.

## MC68000 Microprocessor High Speed Data Acquisition System

Researcher: Captain Grant K. Holcomb, USMC

Sponsor: Naval Academy Research Council (ONR)

There is a present need in the aerospace industry and the Department of Defense for an analog-to-digital data acquisition system which is high speed, low cost, and simple to use. In the research and development environment, it is common to deal with analog signals, in the form of voltages or currents, which possess a linear relationship to a physical phenomenon under analysis. The computational and analytical power provided by computers

makes them essential in this environment. This research project deals directly with providing a high speed, low cost, and user friendly interface between a wide range of analog signals and available computers. By exploiting several new technologies it is feasible to build a system that has the power and speed of a multimillion dollar system, but is more flexible, and easier to use; the cost of this system is less than \$5,000.

## Silicon on Sapphire

Researcher: Associate Professor Tian S. Lim  
Sponsor: Naval Research Laboratory, Code 6810

This research is part of the ongoing SOS (Silicon on Sapphire) material improvement program at NRL. The object of the program is to gain an understanding of the effect of SOS materials preparation on the radiation hardness of high density integrated circuits. The principal means of achieving this is the measurement of interface charge density using the

high-voltage capacitance-voltage technique. In addition, the change in MOSFET parameters as a function of radiation is under study. An attempt will be made to correlate the changes in the Silicon/Sapphire interface with changes in MOSFET parameters.

## Characterization of RAD Hard Microelectronic Devices

Researcher: Professor Richard L. Martin  
Sponsor: Naval Research Laboratory, Code 6810

This is a continuing project, the purpose of which is to develop procedures for testing and evaluations of the effects of different types of nuclear radiation on prototype VLSI components. The different effects

and damage modes due to X-ray, gamma radiation, and neutron radiation are currently under investigation.

## Characterization of Ultrasonic Transducers

Researchers: Professor Antal A. Sarkady and  
Associate Professor (Retired) Herbert M. Neustadt  
Sponsor: Naval Research Laboratory, Code 6810

The aim of this research is to develop network models and measurement systems required to characterize ultrasonic transducers. The precise characterization is required to improve inspection of welds in naval shipyards. During the last year,

seven transducers were tested and characterized by the model developed under this project. Parameter sensitivity and model accuracy are currently under investigation.

## Demonstration of Sonar Principles in Non-Destructive Testing Applications

Researchers: Professor Antal A. Sarkady and  
Assistant Professor William Rynone  
Sponsor: Naval Research Laboratory, Code 6385

This system uses a five megahertz ultrasonic crystal transducer operating in a pulse echo mode. Back-scattered ultrasonic compressional waves (echo signals) are digitized by a 2430 Tektronics sampling oscilloscope and then transferred by the IEEE-488 instrumentation bus to a Hewlett-Packard 9000/310, 32-bit computer. A transferred echo signal can be

examined in the time domain, or its power spectrum can be computed in the frequency domain using a Fast Fourier Transform algorithm.

This technique is widely used in non-destructive testing. For example, it is used in identifying and characterizing weld defects occurring in submarine hulls and nuclear pressure vessels.

# Research Course Projects

## A Non-Directional, Low Frequency Radio Beacon

Researcher: Midshipman 1/C Coleen M. Walker, USN  
Adviser: Assistant Professor William Rynone, Jr.

This project involved the design and construction of the high power, RF amplifier section of a Non-Directional Navigation Beacon Transmitter as part of an undergraduate design project. The student

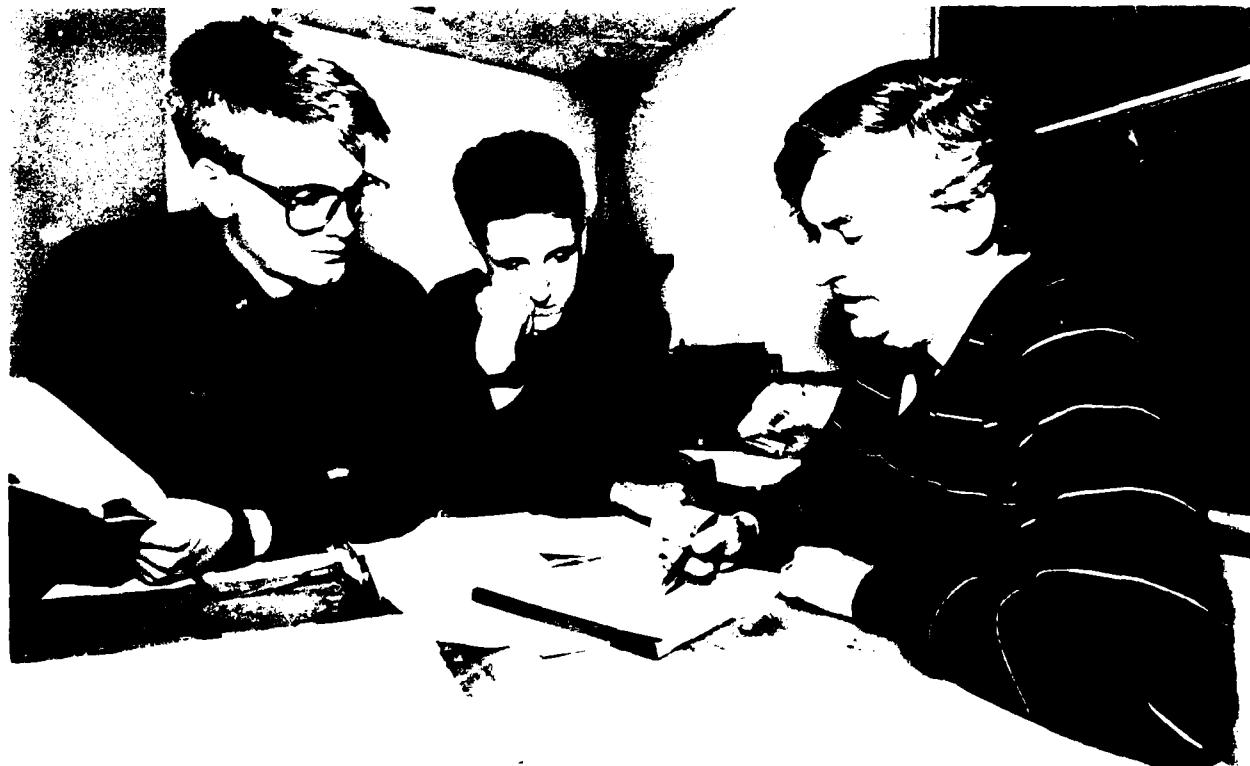
researcher was successful in all phases and intends to complete the other sections of the beacon to make a complete working unit.

## Advanced Laboratory Measurement Devices

Researcher: Midshipman 1/C James L. Gray, USN  
Adviser: Professor Richard L. Martin

The goal of this project was to involve the midshipman in the use of advanced laboratory equipment in practical engineering applications. The principal instrument used was a Hewlett Packard 1631A Logic Analyzer. It was first employed to analyze a tuning problem in a com-

munications handshake protocol between two Apple 2e computers. It was then used to analyze and debug a prototype computer based on the MC68020, 32-bit microprocessor chip. Applications of both the timing and state modes were demonstrated.



## Publications

BROWN, William B., Jr., Lieutenant Commander, USN, "The EE as Naval Officer," *Institute of Electrical and Electronic Engineers Potentials*, October 1987, pp. 45-46.

The career of the Unrestricted Line Officer (URL) is described from the standpoint of opportunities to specialize in the electrical engineering field. The URL officer devotes the first six years of service to training and apprenticeship--"learning the ropes" of the Navy. Thereafter, the most promising are offered the opportunity to earn a masters degree, at Navy expense, and then specialize in engineering applications. Likewise, there are many financial benefits for undergraduates who enroll in either the U.S. Naval Academy or Naval Reserve Officer Training Corps. Typically, an aspiring electrical engineer can arrange to defray all or part of his undergraduate expenses, receive a commission in his early twenties, serve ten years with the opportunity to study for a masters degree, and then be eligible to continue a Navy career as a specialist or transition to the private sector with education and invaluable leadership experience in hand.

BURT, Patricia E., Assistant Professor, co-author, "Improved Method for Pressing Thin Targets From Powders," *Nuclear Instruments and Methods in Physics Research*, A263 (1988), 283-285.

A method for pressing powders or fine granular substances into thin rotatable targets for use in dispersed-beam accelerator experiments is described. As an example, samples of Li<sub>2</sub>S with a diameter of 1.9 cm and a thickness of 21 mg/cm<sup>2</sup> have been produced and successfully tested with a 22 A beam of 305 MeV electrons. The method would be useful for a number of other materials.

MARTIN, Richard L., Professor, co-author, "Characterization of an Ultra-Hard CMOS 64K Static RAM," *Institute of Electrical and Electronic Engineers Transactions on Nuclear Science*, NS-34 (December 1987).

Radiation-hard 64K CMOS static RAMS were irradiated in a Cobalt-60 pool at dose rates of 3 and 70 Rads-(SiO<sub>2</sub>)/second to simulate a space radiation environment. The devices were found to fail due to inability to write a pattern inverse to that stored during irradiation. Periodically tested during the irradiations were various reach characteristics for the RAM cells as well as individual test transistor characteristics.

RYNONE, William, Jr., Assistant Professor, "Annapolis Pilots and Their FBO Band Together to Keep Their Airport Economically Viable," *FBO Magazine*, (March 1988), 16-17.

Most small airports are in the position of being a unique service organization to the community, but their value often goes unnoticed and unrecognized. Although they may serve the community in emergency situations, as well as a port of entry for businessmen and commuters, they are looked upon as a threat to safety and a nuisance. They are under continual pressure to be closed both by local politicians and developers.

This article describes the history and in particular the recent events that occurred that affected a local airport. In particular, the events described include the efforts that were made by the management and pilots to save the airport from closing. These efforts appear to have secured the airport's future for a brief period.

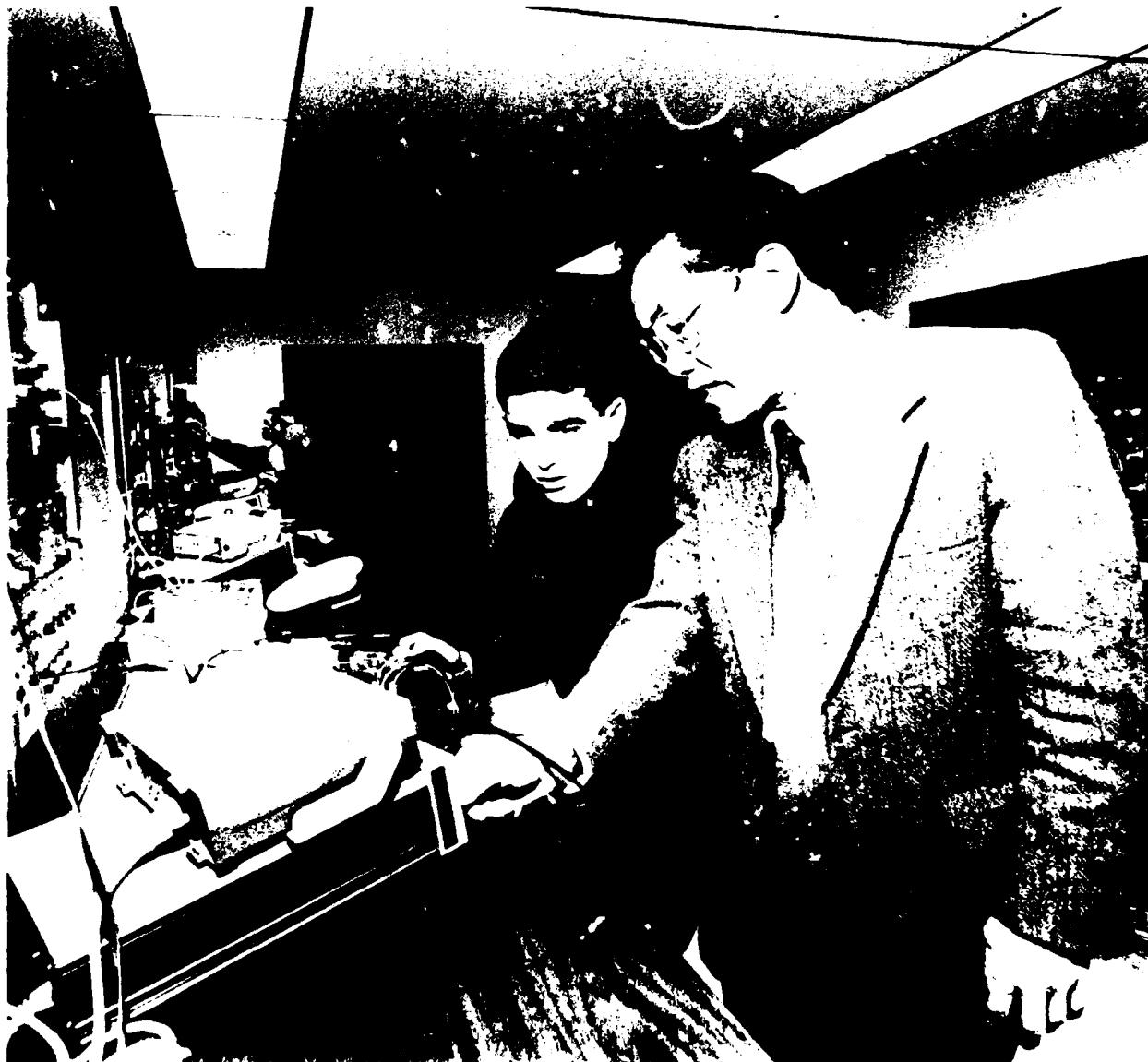
## Presentations

BENNETT, William E., Associate Professor, "Microwave Teaching at the United States Naval Academy," Microwave Teaching Institute, Santa Clara University, Santa Clara, California, 15 July 1987.

LIM, Tian S., Associate Professor, "A Look at Fuzhou University and Engineering Education in China," American Society of Electrical Engineers' Annual Conference, Portland, Oregon, 21 June 1988.

PETERSON, George D., Lieutenant Colonel, USAF, "Accreditation Issues," Fourth Annual Meeting of National Electrical Engineering Department Heads Association, Orlando, Florida, 5-9 March 1988.

SPILLERS, Robert M., Captain, USA, "A Simulation Study of a Limited Sensing Random Access Algorithm for a Local Area Network With Voice Users," Institute of Electrical and Electronics Engineers' Southeastern '88 Conference, Knoxville, Tennessee, 10-13 April 1988.



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# Mechanical Engineering

Professor Joseph D. Gillerlain, Jr.  
Chairman

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Research in the Mechanical Engineering Department encompassed several areas of specialization within the broad field of mechanical engineering. These areas included thermodynamics of internal combustion engines, fluid dynamics, spacecraft mechanical and thermal design, and materials science. Specific objectives of the current research varied from accumulating pure databases for developing predictive methods to effecting changes in pressure vessel codes for use in commercial nuclear power plants.

Research was supported by a variety of sponsors, including the Office of Naval Research, the Nuclear Regulatory Commission and the David Taylor Research Center. The Academic Dean funded several faculty members on instructional development projects. In addition, some faculty pursued unfunded research in areas of personal interest.

Research efforts at the Naval Academy are driven by the need for faculty to stay abreast of rapidly changing technology and subsequently to introduce that new technology into their courses. This updating of course material is also facilitated by seminar speakers and visiting professors. A visiting professor from David Taylor Research Center under a memorandum of understanding taught materials science courses in the department this past year. One professor was co-adviser to a Trident Scholar. The efforts of the mechanical engineering faculty to become more effective classroom teachers through their research activities are reflected by their numerous publications and presentations at national and international conferences.



## Sponsored Research

### Evaluation of Heat Transfer Characteristics of the Heat Barrier Piston Engine

Researcher: Lieutenant Commander David A. Blank, USN  
Sponsor: Naval Academy Research Council (ONR)

The aim of this work is to bring to bear an array of recent developments in the areas of computational fluid dynamics, heat transfer, and combustion on an up-and-coming engine innovation called the "heat barrier piston engine"--with a view to the study of internal regeneration. An extensive computer code already has been developed which solves the conjugate heat transfer problem for the flow of energy

both in the lining of the cylinder and piston top, as well as in the fluid flow field region. The code considers the moving valve case of a 4-stroke engine and employs a hypersolic combustion model. This year's work involves the modeling of radiation heat transfer in the working fluid and the evaluation of the extent of internal regeneration for varying piston barrier strengths.

### Pyscyrometric and Load Analysis for a New Design Piggy-Back Chilled Water Cooling Coil for Use with Advanced Seawater Cooling Coils

Researcher: Associate Professor Elliott E. Dodson  
Sponsor: David Taylor Research Center, Annapolis Laboratory

This project involves ongoing development of criteria and equations for the specification of a piggy-back chilled-water cooling coil for use with new design advanced seawater cooling coils. The

work should culminate in the recommendation of a particular system for certain required design specifications.

### A Study of the Effect of Cultural Changes on Understanding in Technical Areas and Specifically on the Mission of the United States Naval Academy

Researcher: Assistant Professor Shirley T. Fleischmann  
Sponsor: Naval Academy Instructional Development Advisory Committee

The past 15-20 years have been years of rapid technical and cultural change. For example, hand-held calculators and personal computers have become common within that time. These changes alone have affected the lives of everyone, not just those involved in technical careers. The U.S. Navy has increased its level of technical sophistication steadily during this period; therefore, a part of the mission of the Naval Academy is academically to prepare officers for positions requiring a high level of technical competence. Unlike most faculty members who experienced these rapid changes of the

past 20 years in their adult years, most midshipmen experienced these changes in their most formative years.

This study involved interviews, tests, and research aimed at understanding how the technical and cultural changes of the past two decades have affected the expectations and the preparation of students entering the Naval Academy. The preparation to succeed in a highly technical curriculum was studied first, but it was found that "technical literacy" cannot be separated from "cultural literacy" and cultural change.

## U.S. Coast Guard Investigations

Researcher: Professor Joseph D. Gillerlain, Jr. and  
Associate Professor Joseph E. Allen (Aerospace Engineering)  
Sponsor: United States Coast Guard

The U.S. Coast Guard is interested in determining values of hinge moment coefficients for canard control surfaces on twin-hulled platforms. Wind tunnel tests will be planned and conducted to mea-

sure experimentally hinge moment coefficients for a canard fin configuration. The data will be corroborated with other available measurements. A report should be available by December 1988.

## Impact Behavior of Ceramic Matrix Composites

Researcher: Professor Dennis F. Hasson  
Sponsor: Office of Naval Research

The program is to study the effect of impact loading on the mechanisms of crack propagation in ceramic and ceramic matrix composites. Impact loading is accomplished in either an instrumented drop tower or pendulum. The impact velocity can be varied from 0.3 to 3.0 m/s. Also, the impact load can be

slightly varied. Both glass and ceramic matrix materials with continuous and discontinuous fiber are included in the study. In addition, the effect of thermal degradation in air on material toughness will be examined. Supporting microstructural and fractographic analysis will also be performed.

## Variation of Impact Toughness with Temperature for Titanium Aluminum Materials

Researcher: Professor Dennis F. Hasson  
Sponsor: Naval Research Laboratory, Code 6320

The impact toughness of titanium aluminum materials will be determined at various temperatures in the range from room temperature to 1200°C to determine the ductile-to-brittle transition

temperature. Instrumented pendulum or drop tower apparatus will be used to perform the tests. Supporting metallography and scanning electron microscope fractography will be performed.

## Mechanical Property Evaluation of AA Series Aluminum Alloys

Researcher: Professor Dennis F. Hasson  
Sponsor: Naval Surface Weapon Center, White Oak Laboratory

Mechanical testing, primarily instrumented impact testing, will be performed to determine and substantiate the properties of AA series and AA-60B aluminum alloys. These results are required to

increase the database for materials evaluation procedures for submersible materials. Data reduction and analysis, along with scanning electronmicroscopy, will be performed and reported.

## Modified J Application to Static Ductile Fracture Involving Large Crack Growth

Researcher: Professor James A. Joyce  
Sponsor: Nuclear Regulatory Commission

A modified form of the J integral is being proposed for incorporation in the ASME Boiler and Pressure Vessel Code Section II and would be used to verify the safety of commercial nuclear reactor containment vessels. Recent work on this project has shown that this is probably premature since the

modified J integral can lead to non-conservative results if applied improperly. The results of the work were recently presented at the ASME meetings in San Diego and a delay in acceptance of the modified J integral was granted while further study is completed.

## Upper Transition Drop Tower Fracture Test Development

Researcher: Professor James A. Joyce  
Sponsor: Nuclear Regulatory Commission

This is a combination of an ongoing project which over the past five years has led to the development of a drop tower test procedure which obtains full J resistance curves and can be used across a wide range of temperatures and loading rates. New work

has been devoted to tests on large scale specimens and a comparison of results across a range of specimen sizes. Work has also been done to get the test method incorporated in the present ASTM standards for  $J_{Ic}$  and J-R curve testing.

## Effect of Spray Forming Process Parameters on Materials Characteristics and Performance

Researcher: Visiting Professor Angela L. Moran  
Sponsor: David Taylor Research Center, Annapolis Laboratory

Spray forming offers definitive advantages over ingot and powder metallurgy, in that it provides a net or near-net shape route from molten metal to final product with sizable cost savings and enhanced properties. The finished shape exhibits a fine microstructure, reduced segregation, and improved workability. A number of materials and processing parameters influence the final structure.

The objective of this program is to gain an understanding of the interaction between critical processing parameters and the resulting spray-formed materials. In particular, CuNiTi alloys are being evaluated in terms of flight distance, gas pressure, and melt superheat. This work is in cooperation with DTRC and Drexel University.

## Spray Forming Capabilities

Researcher: Visiting Professor Angela L. Moran  
Sponsor: David Taylor Research Center, Annapolis Laboratory

The objective of this program is to develop in-house capabilities for spray forming a variety of alloys. Spray forming is an alternative processing method to ingot metallurgy or powder metallurgy. The finished products exhibit a fine microstructure, reduced segregation, and improved workability and mechanical properties.

A series of binary and engineering alloys are being spray formed for evaluation and comparison to conventionally produced wrought products. This work is being done in collaboration with DTRC and Drexel University.

## Fundamental Studies of the Corrosion of Metal Matrix Composites

Researcher: Visiting Professor Angela L. Moran  
Sponsor: Office of Naval Research

The goal of this program is to understand the effects of a seawater environment on SiC/Al metal matrix composites (MMC) interface regions where corrosion is known to occur. Special interest is

being paid to the precipitate phases that form in 6061 Al MMC. These are being investigated using a variety of electron optic devices. Sample materials are evaluated in the pitted and unpitted states.

## Computers in Mechanical Engineering Design

Researcher: Professor Russell A. Smith  
Sponsor: Naval Academy Instructional Development Advisory Committee

Two new software packages were introduced into EM371, Introduction to Design.

(1) A gear-design computer program was developed for use on the PC's; a design project was initiated with this program.

(2) An introductory instructional package was developed for the ADAMS dynamic simulation pro-

gram in CADIG; a design project was initiated using this software.

The results of this effort have been to complete a set of four computer-aided design projects for the machine design course.

## Computer-Enhanced Instruction in Mechanical Dynamics

Researcher: Professor J. Paul Uldrick  
Sponsor: Naval Academy Instructional Development Advisory Committee

In an attempt to modernize laboratory and classroom instruction in the mechanical engineering curriculum, the principal investigator has acquired four state-of-art digital dynamic measuring systems during the past three years. These include two HP3562 and two B&K 2032 dual channel signal analyzers with experimental modal analysis curve fitting and animation software. Additionally, the department has completely outfitted an electronics classroom consisting of 22 Zenith 248 microcomputers and a color TV projection system for teaching mechanical, thermal, and dynamic system design. By employing modern dynamic data acquisition systems, basic experiments were developed in structural vibrations to give midshipmen enrolled in mechanical vibrations educational experience in experimental modal analysis. This process included

the development of quality instruction software which graphically displays the fundamental concepts of digital signal analysis, including the Fast Fourier algorithms, frequency response functions, sampling concepts, windowing effects, aliasing, and noise effects. Moreover, as an aid in teaching the basics of modal analysis, a graphical computer animation program to solve the six classic Euler-Bernoulli beams, plus a thin closed ring was developed. An eigenvalue-eigenvector program was developed to enhance the students' understanding of lumped parameter modeling. During the past four years the principal investigator has developed an engineering text and graphics processor to use to prepare tests and examinations, lectures, reports, etc., and for his students to prepare their technical laboratory and design reports.

# Independent Research

## Methods for Using Winged-Edge Data Structures for Solid Modeling

Researcher: Professor J. Alan Adams

Research on methods for using winged-edge data structures for solid modeling is being conducted with the help of the CADIG staff. Specifics include calculation of geometric properties and attributes

for intersecting surfaces and solids, translating 3-D wire frame models into solid surface representation, and developing C-code for solid modeling.

## Finite Element Post Processor Development

Researchers: Professor James A. Joyce with Daniel Woodie

The objective of this work has been to develop Fortran software to allow graphic display of finite element results using color graphics terminals and a color ink jet printer. Work to date has produced an ability to display increments of the developing plastic zone during the step-by-step elastic-plastic loading process. Recent work is directed toward

contouring techniques and seeking computer animation which will allow an ability to "watch" the stress field develop near the notch or crack tip as the load is slowly incremented to the final collapse value. This project was developed under the Naval Academy Mentorship Program.



# Research Course Projects

## A Data Structure for Solid Modeling

Researcher: Midshipman 1/C John K. Bailey, USN  
Adviser: Professor J. Alan Adams

The original intention of this study was to compute global properties of solid objects. Specifically, calculations for volume, mass, surface area, and curve intersections were to be performed on slightly complex solids created within the existing Computer-Aided Design/Interactive Graphics (CADIG) facilities. In order to meet the generalized needs of this desire, it was discovered that a boundary representation (B-rep) scheme was required to simplify the process. Boundary representation schemes contain both the geometric description of an object, faces, edges, and vertices, as well as the topological description of the object, the spatial relationships between the geometric entities.

Because of the numerous conveniences associated with the boundary representation scheme, B-reps are one of the most commonly used means of representing data of solid objects. The B-rep scheme simplifies the following functions: determination of internal faces, reduction in the number of possible ambiguous representations of objects, finite element analysis, numerical control machining, and mass properties calculations.

Edge based data structures, a particular type of the B-rep data structure scheme, include an extensive amount of information concerning neighboring objects. Because of the abundance of information contained in edge based data structures, they are

particularly well suited for representing solid objects. Therefore, it was decided that the simplest way to achieve the objectives of this study was to implement a simple solid modeling system which operated on an edge based data structure. The Geometric Workbench (GWB) system described by Marti Mantyla in *An Introduction to Solid Modeling* is such a system and was settled upon for implementation. The primary focus of this paper lies in this system.

In the efforts of trying to implement GWB, a detailed study of the half winged-edge data structure, the underlying facet of Mantyla's techniques, was undertaken. This study of the data structure was necessary in order to be able to implement all of code needed to meet the researcher's objectives.

This paper and its appendices trace the steps which were taken throughout the semester while trying to implement the system described by Mantyla. Also, a detailed description of the Half Winged-edge data structure is included. The areas which were found to have been of particular importance or of extraordinary difficulty are outlined. Suggestions for achieving the initial intentions of this study and for further progress in implementing this system as well as guides for future research are also included.

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## Publications

ADAMS, J. Alan, Professor, co-author, *Descriptive Geometry and Geometric Modeling*. New York, New York: Holt, Rinehart, and Winston, 1988.

The combination of descriptive geometry with geometric modeling provides new possibilities for creative design. This text provides a modern, integrated approach to give a foundation for spatial reasoning and computer solutions to geometry problems. Such an approach is necessary for working in the computer-aided design environment available to the engineering profession today. It also prepares one for later study in advanced geometric modeling and computational geometry related to curve, surface, shape, and solid model definitions.

Vectors are used to represent points, lines, and planes in space. Operations such as dot-product, cross-product, and scalar triple product are used to describe attributes needed for solving geometry problems. The computer expands the traditional methods of descriptive geometry through its ability rapidly to analyze large amounts of data, improve accuracy, and solve complex problems.

The definition of geometric concepts such as points, lines, and planes are discussed from both a graphical and mathematical point of view within the same chapters. Thus, the reader has the option to approach a problem using traditional descriptive geometry, or computational methods based upon modeling. Sample computer programs are given in the Appendix to serve as a guide for those who wish to create similar programs. Commercial software can also be used to generate solutions to typical problems. However, students must first learn to cope with the three-dimensionality of a design problem, especially when a computer does the graphics display work. This text is designed to help meet this need for spatial awareness.

HASSON, Dennis F., Professor, co-author, "Impact Behavior of Fiber Reinforced Glass Matrix Composites," *High-Temperature/High-Performance Composites*, vol. 120, eds. F. D. Lemkoy, A. G. Evans, S. G. Fishman and J. R. Strife. Pittsburgh: Materials Research Society, 1988, pp. 285-290

Ceramic matrix composites with continuous fibers in glass matrices were tested with instrumented impact

apparatuses. The composite architectures were unidirectional ( $0^\circ$ ) and crossply ( $0/90^\circ$ ). For the  $0/90^\circ$  laminates, interlaminar and edge on orientation specimens were tested. An orientation dependence was observed. The CMC material with a weaker fiber/matrix interfacial bond had longer fiber pullout, and hence due to the frictional sliding mechanism higher dynamic work to fracture. In the fracture analysis discussion it is suggested that the use of the LEFM,  $K$ , parameter should be qualified in the fracture testing of CMC materials. These qualified toughness  $K$  values were found to be in the range of those reported for metal matrix composites.

JOYCE, James A., Professor, co-author, "Transition Range Drop Tower J-R Curve Testing of A106 Steel," *Proceedings of the 1987 Society of Experimental Mechanics Fall Conference*, Savannah, Georgia, 25-28 October 1987, pp. 86-91.

Fracture toughness properties should be measured in the laboratory at loading rates and temperatures similar to those expected in the application of interest. This is not usually the case because of the experimental difficulties involved. This report describes a method being used to obtain  $J_{Ic}$ , J-R curves, and  $J$  at cleavage for three point bend tests conducted at drop tower rates through the ductile to brittle transition regime of the ferritic A106 steel being tested. The major conclusion is that these tests can now be accomplished, though a high degree of expertise and considerable practical experience is necessary to obtain good test results. The steel tested here is quite rate dependent as shown both by tensile tests and fracture toughness tests. A load elevation of 30-50% results in the drop tower 100 in/second tests on this material in comparison with static tests when both tests are conducted on the ductile upper shelf. Nonetheless, for this material  $J_{Ic}$  and J-R curves are not elevated by the loading rate. Looking at the elastic and plastic components of  $J$ , one sees that the  $J_{EL}$  increases with loading rate but also that  $J_{PL}$  decreases with loading rate. Also it is demonstrated that for the high rate tests, more crack extension is present at a given bend angle for the rapid tests in comparison with the static tests.

## MECHANICAL ENGINEERING

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JOYCE, James A., Professor and Carl S. SCHNEIDER, Professor of Physics, "Crack Length Measurement During Rapid Crack Growth Using an Alternating-Current Potential Difference Method," *Journal of Testing and Evaluation*, 16, 3 (May 1988), 257-270.

The object of this project has been to investigate the applicability of an alternating-current potential difference method of crack length estimation to rapid loading fracture mechanics tests in ferromagnetic materials. The more commonly used direct-current method has been demonstrated to be very sensitive to induced magnetization under rapid loadings. The resulting direct-current output signal is complex and not repeatable, and the component related to crack extension cannot be separated from the total response. The tests reported here show calibrations of a 10 kHz alternating-current system on an A533B material and application of the calibration to a static unloading compliance test and to rapid servohydraulic tests. A d-c component dependent on stress-induced magnetization is still present but can now be separated from the high frequency component using Fourier series methods.

The major conclusion is that an alternating-current technique with a properly chosen excitation frequency can be used to detect crack growth in rapidly loaded specimens. Additional comments on developing an improved system are presented.

MORAN, Angela L., Visiting Professor, co-author, "Evaluation of Near Net Shape Alloy 625 Tubular Preforms for Seawater Piping," *Progress in Powder Metallurgy*, 43 (1987), 711-721.

A task to evaluate near net shape production techniques for manufacture of Alloy 625 piping was initiated at David Taylor Research Center. Preforms produced via spray forming have been characterized and were extruded to form thin walled piping. Spray deposited preforms exhibit a uniform, equiaxed microstructure and are well suited to the roll extrusion process utilized for Alloy 625. Piping produced from spray formed preforms exhibits properties that exceed those for conventionally manufactured piping. Initial costs evaluation indicates a sizable cost reduction for production of Alloy 625 via the spray forming technique as opposed to current technology.

MORAN, Angela L., Visiting Professor, "Evaluation of Spray Formed Alloy 625 Preforms for Seawater Piping Applications," DTRC/SME-87-77, October 1987.

Potential near net shape manufacturing methods have been evaluated to determine cost advantages and product quality as compared to conventional manufacturing technology for production of large

diameter Alloy 625 piping. One particular method, Osprey spray forming, has proved a viable alternative. The spray formed preforms exhibit uniform, equiaxed microstructures and mechanical properties equal to those for wrought product. The reduced piping produced via spray forming has mechanical properties that surpass those established by current specifications, while the microstructure remains fine after cold rolling. In addition, cost evaluation indicates sizable cost savings for production.

MORAN, Angela L., Visiting Professor, co-author, "Evaluation of Crystallinity, Orientation, and Performance of Carbon Graphite Seal Materials," DTRC/SME-87-78, October 1987.

Commercially manufactured carbon graphite seal materials were evaluated in terms of their structure, crystallographic orientation, and tribological behavior. A variety of electron optical techniques were utilized to assess the effects of wear on the structure of the carbon graphite materials. Percent crystallinity for the manufactured carbon varied from 35 to 60%. These materials demonstrated a degree of orientation, with one face in particular indicating a distinctly different orientation. The face showing preferred orientation also responded differently to wear, indicating a better tribological response than the other faces.

MORAN, Angela L., Visiting Professor, co-author, "Characterization of Surface Damage Due to Low Amplitude Slip," DTRC/TM-28-87-48, September 1987.

Included in this report is the progress made to date in a cooperative system involving David Taylor Research Center, Naval Air Development Center, and Wear Sciences Corporation. This program is concerned with the effect of low amplitude slip on the surface damage in rolling and sliding contact. Present investigations involve various ceramic/metal and ceramic/ceramic material combinations.

MORAN, Angela L., Visiting Professor, co-author, "Analysis of Spray Deposited Alloy 625 Using Transmission Electron Microscopy," DTRC/TM-28-87-50, December 1987.

Samples from eight-inch diameter spray deposited Alloy 625 preforms and reduced piping, in both the annealed and non-annealed condition, were prepared as 3mm disks with thicknesses of approximately 150 microns. Final thinning was performed via electrochemical jet polishing.

The two main types of precipitates found using transmission electron microscopy were titanium-niobium carbide precipitates and niobium carbide precipitates. Additionally, an iron-chromium precipitate has been observed.

## MECHANICAL ENGINEERING

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WHITE, Richard W., Lieutenant Commander, USN, co-author, "Ordnance on Target: The Improved 16-Inch Gun Weapon System," *Naval Engineers Journal*, 100, 3 (May 1988), 194-203.

The Iowa class battleships are being returned to active service without significant modifications to their 16-inch Gun Weapon System (GWS). The ordnance, 16-inch guns, and associated fire control equipment are currently 1940's vintage technology. The reactivation was accomplished without significant modernization to the gun system's due primarily to funding limitations. In the late 1970's naval gunfire had fallen out of vogue and no pressing need for 16-inch GWS improvements existed.

With the development and subsequent deployment of the landing craft air cushion (LCAC) and the MV-22A Osprey, naval surface fire support (NSFS) of Marine amphibious operations was re-examined. Specifically, the means of generating supporting fire from surface combatants required extensive analysis. The resulting analysis indicated that the most cost-effective partial solution to the problem was an extensive modernization of the 16-inch GWS where the range lethality, and response time of the weapon would be significantly improved.

Except for the gun turrets themselves, the 16-inch GWS will be almost completely modernized. Extensive modification of the ordnance and fire control system will be accomplished.

This paper first discusses the reasons for the improvement in the 16-inch GWS. It describes, in detail, the new 16-inch ordnance under development, highlighting the operational issues which drive the engineering approach. Finally, the new gun fire control system (FCS) is described. The advantages of streamlining with digital equipment are highlighted. Some unique features of the FCS, which are appropriate in its operational environment, are discussed.

WU, Chih, Professor, "A Performance Bound for Real OTEC Heat Engines," *Journal of Ocean Engineering*, 14, 4 (1987), 349-354.

Maximum power and efficiency at the maximum power of an irreversible OTEC heat engine are treated. When time is explicitly considered in the energy exchanges between the heat engine and its surroundings, it is found that there is a bound on the efficiency of the real OTEC heat engine at the maximum power condition. This bound can guide the evaluation of existing OTEC systems or influence design of future OTEC heat engines.

WU, Chih, Professor, "Modeling and Simulation of a Naval Shipboard Heat Pump," *International Journal of Modeling and Simulation*, 7, 3 (1987), 97-105.

A computer simulation model has been developed for a water-to-water heat pump. The simulation

model is intended to evaluate the thermal performance of this water-to-water heat pump system. It can also be used as a computer-aided design analysis tool, since it has many built-in design options. The modeling techniques used and the different types of operational modes and component options relevant to shipboard environment are presented.

WU, Chih, Professor, "Probabilistic Modeling and Simulation of Multi-phase Interface and Interaction Problems," *International Journal of Modeling and Simulation*, 7, 3 (1987), 106-112.

As two rough surfaces approach each other, the in-surface asperities begin to contact at a discrete number of points. The real contact area increases as the applied load increases. The degree of contact, which is a strong function of the number and nature of surface asperities, has a significant influence on the heat conduction behavior across the contracting gap and on the carrying capacity of a lubricated bearing.

This paper presents a stochastic modeling and a finite element formulation in which effects due to the interference of asperities are included in the form of a truncated normal probability density function. The conventional heat conduction equation and the Reynold's equation of lubrication are modified. The work introduces the finite element method into the realm of stochastic processes, and may help to simulate and resolve such problems as gap heat conduction and film lubrication, where discrete microscopic effects cannot be ignored and where using each finite element as a continuum fails.

Although this paper is limited to gap heat conduction and thin film lubrication, the same concept can be readily generalized to other field problems, such as fluid-fluid interfaces, solid-fluid interaction, etc.

WU, Chih, Professor, "Choice of Working Fluids for Non-Azeotropic Mixed-Refrigerants Air Conditioning System," *Journal of Energy Conversion and Management*, 27, 4 (1987), 385-387.

Non-azeotropic mixed-refrigerants air conditioning is a potential energy saving process of removing heat from a space. Desirable non-azeotropic mixed refrigerants should possess physical, thermodynamic, and chemical properties which permit their efficient operation in air conditioning systems. In addition to economical considerations, there should be no danger to health in case of their escape due to leaks or other causes in an air conditioning system. These physical, thermodynamic, chemical, economical safety, and specific properties are listed and discussed briefly in this paper.

## MECHANICAL ENGINEERING

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WU, Chih, Professor, "Potential Naval Shipboard Application of Non-Azeotropic Energy Conversion," *The Naval Engineers Journal*, 99, 6 (November 1987), 39-51.

The thermodynamic performance of an energy conversion device may be improved potentially by using a non-azeotropic mixture in a vapor cycle. A non-azeotropic mixture has a temperature distribution parallel to that of the surrounding fluid with which heat transfer takes place during the evaporation and condensation processes. Interest has increased in recent years in the use of non-azeotropic refrigerant mixtures to improve the performance of energy conversion devices. This report surveys developments in non-azeotropic energy conversion, describes the theory of a non-azeotropic energy conversion cycle, predicts energy savings possible from use of non-azeotropic conversion devices, and discusses potential naval shipboard application of such an energy conversion cycle.

WU, Chih, Professor, "New Age of Satellite Education," *The Journal of Education Technology Systems*, 16, 3 (1988), 231-238.

A new age of satellite education has emerged during the last decade. The world has seen tremendous progress in all facets of space research in the recent past, especially after man's successful moon landing in 1969. Today, multispectral scanners and modern sensors on different satellites which are orbiting the earth are continuously sending repetitive coverages of the earth which enable us to identify, manage,

and monitor the various natural resources in the pursuit of human welfare on a global basis. This important aspect has necessitated a change in educational methodologies. Making use of the satellite for educational purposes is a challenge to institutes of higher technologies, universities, and research organizations. Developed countries will have to extend their helping hands to the developing countries with respect to infrastructural facilities and guidance in educational programs, so as to reap the fruits of satellite-based remote sensing in using repetitive and synoptic digital data from satellites for human welfare and happiness. An attempt is made in this article to present the state-of-the-art of the satellite technological education. The feasibility of applying satellite education by China for distance learners, foreigners, and oversea Chinese is also discussed in the article.

WU, Chih, Professor, "Output and Efficiency Upper Bounds of Real Solar Heat Engines," *International Journal of Ambient Energy*, 9, 1 (January 1988), 17-21.

Maximum power and efficiency at the maximum power of an irreversible solar heat engine are treated. When time is explicitly considered in the energy exchanges between the solar heat engine and its surroundings, it is found that there is a bound on the efficiency of the real solar heat engine at the maximum power condition. This bound can guide the evaluation of existing solar power generating systems or influence design of future solar heat engines.

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# Presentations

ADAMS, J. Alan, Professor, "Descriptive Geometry and Geometric Modeling," American Society of Engineering Educators National Meeting, Portland, Oregon, 19-23 June 1988.

FLEISCHMANN, Shirley T., Assistant Professor, "The Right Stuff for Success in Engineering, Science, and Mathematics," Electrical Engineering Department, United States Naval Academy, Annapolis, Maryland, 24 November 1987.

FLEISCHMANN, Shirley T., Assistant Professor, "Issues for Women Professionals in Engineering," University of Maryland, College Park, Maryland, 7 December 1987.

HASSON, Dennis F., Professor, "Impact Behavior of Ceramic Matrix Composite Materials," Sixth International Conference on Composite Materials, London, England, 20-24 July 1987.

HASSON, Dennis F., Professor, "Flexural Fatigue Behavior of Aramid Reinforced Aluminum 7075 Laminate (ARALL-1) and Al 7075 Alloy Sheet in Air and in Salt-Laden Humid Air," Sixth International Conference on Composite Materials, London, England, 20-24 July 1987.

HASSON, Dennis F., Professor, "Impact Behavior of Fiber-Reinforced Glass Matrix Composites," Materials Research Society 1988 Spring Meeting, Reno, Nevada, 6 April 1988.

JOYCE, James A., Professor, "Application of  $J_D$  and  $J_M$  to Develop Size Independent J-R Curves for Large Crack Growth," Nuclear Regulatory Commission Sponsored Review of  $J_M$  Methodology, David Taylor Research Center, Annapolis, Maryland, 4 August 1987.

JOYCE, James A., Professor, "J-R Curve Testing of Ferritic Steel in the Toughness Transition Range," 1987 Society of Experimental Mechanics Fall Conference on Dynamic Fracture, Savannah, Georgia, 25-28 October 1987.

JOYCE, James A., Professor, "Development of Specimen Size and Test Rate Effects on the J-Integral Upper Transition Behavior of A533B Steel," Nuclear Regulatory Commission Reactor Safety Review, Gaithersburg, Maryland, 28 October 1987.

JOYCE, James A., Professor, "Development of J-R Curves Involving Large Crack Growth," Fall 1987

American Society of Mechanical Engineers Section II Working Group Meeting, San Diego, California, 19 January 1988.

JOYCE, James A., Professor, "Modification of ASTM E813 for Transition Range Dynamic and Static Testing," American Society of Testing Materials Spring Committee Week Meeting, Reno, Nevada, 26 April 1988.

MORAN, Angela L., Visiting Professor, co-author, "Materials Processing Research Opportunities: U.S. Perspective," Bilateral Workshop on Advanced Techniques of Materials Characterization, Solidification, and Materials Processing, Hyderabad, India, 11-21 January 1988.

MORAN, Angela L., Visiting Professor, co-author, "Alloy 625 Piping Produced via Spray Forming," International Powder Metallurgy Conference, Orlando, Florida, 5-10 June 1988.

SMITH, Russell A., Professor, co-author, "Measurement Protocol for Quantifying Vehicle Damage," 1988 Society of Automotive Engineers Annual Conference, Detroit, Michigan, 29 February - 4 March 1988.

WHITE, Richard W., Lieutenant Commander, USN, "Big Guns are Back and Getting Bigger," Philadelphia Section of Society of Naval Architects and Marine Engineers, Philadelphia, Pennsylvania, 1 October 1987.

WHITE, Richard W., Lieutenant Commander, USN, "Ordnance on Target - The Improved 16-Inch Gun Weapon System," American Society of Naval Engineers Annual Meeting, Washington, DC, 5 May 1988.

WU, Chih, Professor, co-author, "Development of a Solar Absorption Air Conditioning System," International Symposium on Identification, Modeling, and Simulation, Paris, France, 22-24 June 1987.

WU, Chih, Professor, "A Performance Bound of a Real Refrigerator," Twenty-second Intersociety Energy Conversion Engineering Conference, Philadelphia, Pennsylvania, 10-14 August 1987.

WU, Chih, Professor, "New Age Satellite Technological Education," Chinese-American Professional Association of Metropolitan Washington, DC Annual Meeting, Washington, DC, 15-16 August 1987.

## MECHANICAL ENGINEERING

WU, Chih, Professor, "Optimal Performance of a Cascade Endoreversible Cycle," 1987 American Society of Mechanical Engineers Winter Annual Meeting, Boston, Massachusetts, 13-18 December 1987.

WU, Chih, Professor, "Modeling and Simulation of a Time-Control Single Tidal Pool Power System," International Conference of Modeling and Simulation, Pomona, California, 16-18 December 1987.

WU, Chih, Professor, "Power and Efficiency Limits of Real Solar Pond Heat Engines," International

Conference of High Technology in the Power Industry, Phoenix, Arizona, 1-4 March 1988.

WU, Chih, Professor, "Engineering Performance Bound of an Irreversible Thermoelectric Power Generator," Seventh International Conference on Thermoelectric Energy Conversion, Arlington, Texas, 16 March 1988.

WU, Chih, Professor, "A Pressurized Environmental System for Tall Buildings," Fourth International Conference on Tall Buildings, Hong Kong and Shanghai, China, 22 April - 6 May 1988.





# Naval Systems Engineering

Professor Rameswar Bhattacharyya  
Chairman

The Naval Systems Engineering Department conducted scholarly research and professional development works most vigorously in ocean engineering and naval architecture, as well as in marine engineering during the academic year 1987-1988. Faculty members and midshipmen took part in numerous sponsored and non-sponsored research activities, including the Trident Scholar program. A number of faculty members also participated in non-funded research and directed senior level midshipmen in their research activities, utilizing the excellent laboratory and computer facilities available to this department.

The Department continued to participate actively in professional society meetings and conferences, both nationally and internationally. Research results have been published in journals and technical publications, or presented at national and international seminars. The outcome of the Department's deep involvement in research by the civilian and military faculty members is reflected in the academic environment in the classroom for professional and majors courses.

Research themes of the Department faculty were varied. They included planing landing craft analysis, statistical and experimental studies of wave groups, gas turbine exhaust analysis, mooring experiments, computer-aided instruction, U.S. Navy dive system development, the use of laptop computers in engineering education, and the effects of transom geometry on large surface combat ship resistance.

Research funding was made available from many sources including departmental operating funds, and contracts and grants from various organizations such as the Naval Academy Research Council, Instruc-



tional Development Advisory Committee, Office of Naval Research, Naval Facilities Engineering Command, Naval Sea Systems Command, Naval Coastal Systems Center, and David Taylor Research Center.

# Sponsored Research

## Experimental Analysis of a Planing Landing Craft (LCX)

Researcher: Professor Roger H. Compton

Sponsor: Naval Sea Systems Command

(COMBAT Systems Engineering Station, Norfolk, Virginia)

Powering estimates for the planing landing craft at three displacements at each of three static trim conditions in calm water were made, based on tests conducted in calm water in the U.S. Naval Academy's 380-foot towing tank. Scaled speeds from 5 to 50 knots were studied using a one sixteenth scale model provided by the sponsor. Low speed astern powering estimates were also made.

Vertical accelerations at three longitudinal locations and powering in irregular head and following seas corresponding to a NATO Sea State 3 were also quantified by experimental means.

Scale effects on powering were evaluated on the basis of testing a one thirty-second scale model in the USNA 120-foot tank. The smaller model was also tested in shallow water.

## Wave Group Statistics

Researchers: Professor Thomas H. Dawson,

Assistant Professor David L. Kriebel,

Louise A. Wallendorf, Ocean Engineer, and

John R. Hill, Naval Architect

Sponsor: Office of Naval Research

The objective of this investigation is to determine the statistics of wave groups in random seas. The project is a continuing study, first funded by ONR

in 1985. The work involves both experimental measurements in the U.S. Naval Academy's 380-foot towing tank and numerical simulations.

## Experimental Analysis of Wave Groups

Researchers: Professor Thomas H. Dawson,

Assistant Professor David L. Kriebel, and

Louise A. Wallendorf, Ocean Engineer

Sponsor: Office of Naval Research

Two existing theories for wave group statistics were evaluated using wave records from the U.S. Naval Academy's 380-foot wave tank. Wave group characteristics, such as the time duration of a group and the time interval between groups, were evaluated by comparing probability density functions as well as

average or expected values. In general, neither theory was found to be accurate to within more than about 30 percent. Results of the data analysis did suggest, however, that simple scaling laws based on dimensional analysis can be used to obtain accurate estimates of wave group statistics.

# NAVAL SYSTEMS ENGINEERING

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## Gas Turbine Exhaust Flow Distribution Analysis

Researchers: Lieutenant Wayne J. Harman, USN and  
Associate Professor John E. Allen  
(Aerospace Engineering Department)  
Sponsor: David Taylor Research Center,  
Annapolis Laboratory

This project is a continuing analysis of gas turbine exhaust flow as part of a larger effort to evaluate the design projections of the major competitors in the Inter-Cooled-Regenerated (ICR) gas turbine

effort. This year's work included setting up a laser doppler velocimeter to measure velocities in a gas turbine exhaust flow field.

## An Integrated, Computer-Aided Hull Form Design Package for Mission Effectiveness Analysis at the U.S. Naval Academy

Researchers: Professor Bruce Johnson,  
Assistant Professor Gregory J. White, and  
Assistant Professor Nicolaos Glinos  
(Computer Science Department)  
Sponsor: Defense Advanced Research Project Agency

This project is a collaborative research with industry effort to improve an existing computer-aided hull form design and analysis system used by two recent Trident Scholars and all the Naval Architecture majors in the Class of 1988. The existing system was developed under contract by Design Systems and Services, Inc. and SAIC, Inc., both of Annapolis, Maryland. The current contract calls for members of the Naval Academy faculty to work with the developers of the system to integrate more fully the hull geometry codes with the various analysis codes proposed for the new system. These analysis codes include an existing slender body resistance code which requires improvements in the sinkage and trim calculations, a set of resistance codes based on historical databases, a linear sea-

keeping code to be developed by SAIC, a non-linear seakeeping code to be developed by SAIC to run on a supercomputer, a simplified structural design and analysis code to be developed by Professor White, and various design criteria evaluation codes to be developed by the whole team. One of the first tasks is to determine whether a standard ship geometry file format can be developed which will enable the various geometry codes to communicate readily with various analysis codes. One possibility being investigated is the use of a database which includes the ship characteristics, the necessary offset files, surface panel files or descriptors, and other information in standardized locations in the database files.

## Single Point Mooring Model Tests

Researcher: Assistant Professor David L. Kriebel  
Sponsor: Naval Facilities Engineering Command

A series of laboratory model tests are being conducted in the U.S. Naval Academy's large wave tank to determine viscous damping coefficients for an FFG model undergoing slow (low frequency)

oscillations. These coefficients will be used in a numerical model, also under development, to predict the time-dependent dynamic response of the ship in a single point mooring.

## Spread Sheet Instruction for EN200, Naval Engineering I

Researcher: Associate Professor Thomas J. Langan  
Sponsor: Naval Academy Instructional Development Advisory Committee

The purpose of this project is to develop methodology and course instructional material to be used by EN200 instructors. This material will be used both to teach the basics of the SuperCalc4

spread sheet program, and also for work with selected homework problems, laboratory exercises, and specially assigned computer projects.

## Micro-Computer-Aided Instruction for EN300, Naval Engineering II

Researcher: Assistant Professor Keith W. Lindler  
Sponsor: Naval Academy Instructional Development Advisory Committee

The purpose of this project was to develop a "user friendly" computer model which could be used to study the Rankine steam power cycle. A student spending two hours using this software is able to gain a better insight into the performance of the Rankine cycle than could be obtained by long and tedious calculations using the steam tables. Furthermore, the program helps to convince the

student of the timesaving ability of the computer and encourages him to use computers for other applications.

In the Fall Semester 1987, the program was successfully used by three sections of EN361 and one section of EN300. In the Spring Semester, the program was used by all EN361 and EN300 sections.

## Computer-Aided Instruction for the Ocean Engineering Major

Researcher: Associate Professor Robert H. Mayer, Jr.  
Sponsor: Naval Academy Instructional Development Advisory Committee

The primary objective of this project was to develop and implement a plan for computer integration into the required and elective design courses of the ocean engineering major. Accordingly, the researcher developed lesson plans and exercises to support classroom instruction in the fundamentals of DOS, SuperCalc4 and DRAFIX. Also, three fully-interactive computer programs were developed using the macro capabilities of SuperCalc4: Timber

Column Analysis by Spreadsheet; API Offshore Column Design by Spreadsheet; and Engineering Economics by Spreadsheet. While the latter programs provide the student with limited capability to design structural columns and perform economic evaluations, their principal function is to expose users to the capabilities and advantages of spreadsheet computations in support of design and project management decisions.

## Analysis Efforts for the U.S. Navy Conventional Dive System

Researcher: Assistant Professor Marshall L. Nuchols  
Sponsor: Naval Coastal Systems Center

As part of the continuing development of the U.S. Navy Conventional Dive System, EX19-1, a number of areas were investigated experimentally and analytically, to identify design problems and evaluate solutions. A thermal analysis was conducted on the active heating alternatives available for the dive

system, as well as on the Thinsulate undergarments and the S-Tron thermal models and controllers. The researcher also reviewed the S-Tron tube suit design, including consideration of future design concepts. Finally, he reviewed scrubber results obtained both at Duke University and at S-Tron.

## Shipboard Gas Turbine Duct Size Reduction

Researcher: Associate Professor Kenneth L. Tuttle  
Sponsor: Naval Academy Research Council (ONR)

The purpose of this ongoing research program is to make calculations and optimizations for Naval Sea Systems Command of gas turbine exhaust duct size, shape, and pressure drop for a proposed new design for marine power plants. The initial phase, conducted this year, was to make contact with the

Navy personnel responsible for gas turbine duct design, and to accumulate background data and information upon which duct design is based. This basic research will be especially useful in future ship applications where use of inter-cooling regenerators is planned.

## Laptop Computers in Engineering Education

Researcher: Assistant Professor Gregory J. White  
Sponsor: Naval Academy Instructional Development Advisory Committee

The purpose of this project is to evaluate the relative merits of having engineering students use battery-powered portable "Laptop" computers vice the conventional desktop models. This was accomplished by providing two select groups of engineering students and their faculty with roughly equivalent computers; one group receives desktop systems, the other receives laptop systems. The

computer usage of each group is monitored via weekly usage logs kept by all participants. Both the faculty and student participants are given a series of questions to answer during each semester of the project in an attempt to quantify the computer system's ability to enhance learning of the course material.

## The Effects of Transom Geometry on the Resistance of Large Surface Combatants

Researcher: Midshipman 1/C Thomas K. Kiss, USN  
Adviser: Professor Roger H. Compton  
Sponsor: Trident Scholar Program

This is an investigation into the calm water resistance characteristics of a series of transom-sterned ships. Five transom shapes and their corresponding afterbodies were designed to examine the effect of draft and beam at the transom on ship resistance. There were two draft and two beam variations from a common baseline hull. The forebody was held constant for all five designs.

Each of the variations represented typical surface combatants of the frigate/destroyer family. Models were built of each hull and still water resistance tests were run in the 380-foot towing tank at the U.S. Naval Academy's Hydromechanics Laboratory. Analytical studies of each hull were performed using existing potential flow code algorithms.

# Independent Research

## Ship Dynamics

Researcher: Associate Professor Thomas J. Langan

The purpose of this research is to develop methods for predicting ship motions in beam seas. The differential equation of motion is being solved numerically, and a series of experimental results are being studied to provide data to compare with the

numerical solution. A solution to the differential equation for roll has been constructed; the next phase is to incorporate the linear motions--heave and sway.



## Research Course Projects

### Carbon Dioxide Removal Via Semi-Permeable and Liquid Membrane Technology

Researcher: Midshipman 1/C Roger W. Bivans, USN  
Adviser: Assistant Professor Marshall L. Nuckols

This project involved the study of the removal of carbon dioxide from human respiration. An apparatus using liquid-membrane technology was set up in the Coastal Engineering Laboratory of Rickover Hall. The process involves diffusing a CO<sub>2</sub>-laden gas simulating human expiration into seawater and then siphoning out the dissolved gases.

The removed gases are then tested for the amounts of CO<sub>2</sub> and O<sub>2</sub> present. Temperature, gas flow rate, seawater flow rate, and salinity are varied in order to determine the optimal parameters necessary for human consumption of the scrubbed gases. In addition, the feasibility of using semi-permeable membranes is being researched.

### Microcomputer-Aided Engineering Design Study for Offshore Anchors

Researcher: Midshipman 1/C William C. Cook, USN  
Adviser: Associate Professor Robert H. Mayer, Jr.

The objective of this research project was to explore the capabilities of a microcomputer spreadsheet-based program in support of investigating design procedures for offshore anchors. The investigation included two principal anchor types: the deadweight

anchor and the pile anchor. Each design procedure was computerized into an interactive, user-friendly spreadsheet program to facilitate engineering design of deadweight and pile anchors as applied to practical ocean engineering situations.

### Diver Assist Oceanographic Research Vehicle Design

Researcher: Midshipman 1/C Alan D. Czeszynski, USN  
Adviser: Assistant Professor Marshall L. Nuckols

The objective of this project is to complete a preliminary design of a diver assist Oceanographic Research Vehicle capable of operating at depths down to 300 feet of seawater and speeds of up to six knots. A scale model was fabricated in order to

conduct drag studies in the U.S. Naval Academy's 120-foot tow tank to determine propulsion needs. Also included in this project is research into low drag hydrodynamic forms.

## Experimental Study of a Buoyant Compliant Tower

Researcher: Midshipman 1/C Peter G. Dunphy, USN  
Adviser: Professor Michael E. McCormick

A model of a Buoyant Compliant Tower (BCT) was tested in the U.S. Naval Academy's 120-foot wave and towing tank. The model configuration was a cylindrical structure mounted on a swivel. Since the natural "swaying" frequency of the tower is a function of the mass moment of inertia, a movable internal mass was used for frequency adjustment. This is a critical design feature of the model, since the "Compliant Tower" frequency must be less than

half the wave frequency. This results in an inertial reaction of the fluid-structure system that actually opposes the wave force. Hence, the net force on the swivel and seafloor is far less than that on a rigid tower. The variables studied included wave properties (height and period), structural displacement, and the force on the base. The wave frequency range used spanned the resonant frequency.

## Random Wave Comparison

Researcher: Midshipman 1/C Rasheed El-Moslimany, USN  
Adviser: Assistant Professor David L. Kriebel

Wave records were analyzed to determine the probability density functions of water surface elevations, wave heights, and wave periods. The data used in the analysis consisted of wave time series generated on the computer, as well as generated in the U.S. Naval Academy's large wave tank. The objective of the project was to determine the linearity of wave tank data by comparing experi-

mental probability functions to standard theoretical forms. The research results indicate a high degree of correlation between the wave tank records and computer generated records which are known to be purely linear. Water surface elevations were also found to agree with a Gaussian distribution. However, wave heights did not follow the Rayleigh probability function.

## Coastal Protection by a Pneumatic Wave Energy Conversion Array

Researcher: Midshipman 1/C Jeffery A. Kendrick, USN  
Adviser: Professor Michael E. McCormick

The purpose of this experiment was to study wave energy conversion models for co-use as breakwaters. These models were configured in an array to provide "coastal protection" in order to improve the cost-effectiveness of the system. Three models were built using a scale of 1/33 with reference to the full-scale Norwegian system. The materials used for construction of the models were plexiglass and epoxy. The researcher tested the models in the coastal engineering tank using a series of waves

having various frequencies and heights. The first group of tests determined wave properties (natural frequency, orifice damping, etc.) within the models. The second group of tests determined the model array's efficiency as a breakwater. Transmission was studied in the test by varying the distance between models and by measuring both incident and transmitted wave heights. The last series of tests were designed to determine wave energy efficiency of the models.

## An Experimental Analysis of Riblet Application for Turbulent Drag Reduction

Researcher: Midshipman 1/C Dennis J. McKelvey, USN  
Adviser: Visiting Professor David W. Coder

A series of tests was conducted in the U.S. Naval Academy's 380-foot towing tank to examine the drag reduction characteristics of longitudinal riblets. These tests were performed on two single man rowing shells borrowed from the U.S. Naval Academy's rowing team. Three aspects of the drag

reduction were examined. First, the tests sought to quantify the actual percentage of drag reduction; second, to determine any degradation in the drag reduction over time as a result of fouling of the riblet surface; and finally, to observe the effect of trapped air in the riblet surface.

## Wave Group Analysis

Researcher: Midshipman 1/C David Robillard, USN  
Advisers: Professor Thomas H. Dawson and  
Assistant Professor David L. Kriebel

The researcher performed statistical analysis on wave time series in order to determine the average duration and interval associated with wave groups. The time series were synthetically generated on the computer, based on various standard wave spectra. Data analysis consisted of fitting an envelope func-

tion through wave crests and then determining wave group durations and time intervals between groups for various elevation thresholds. Once this data was obtained, several predictive equations were developed based on dimensional analysis as well as regression techniques.

## Improving Subsonic Diffuser Performance

Researcher: Midshipman 1/C Douglas A. Tucker, USN  
Adviser: Associate Professor Kenneth L. Tuttle

The objective of this research is to determine an adequate method of predicting subsonic diffuser performance. The adverse pressure gradient of the diffuser induces flow separation, and stall is induced

at higher rates of divergences. Also considered was the role of middle bodies at the inlet of diffusers, which increase the size of the boundary layer at the inlet, thereby improving performance.

## Publications

JOHNSON, Bruce, Professor, and Louise A. WALLENDORF, Ocean Engineer, "The Kinematics of Deep Water Breaking Wave," Proceedings of the IAHR Seminar on Wave Analysis and Generation in Laboratory Basins, Lausanne, Switzerland, September 1987, pp. 411-422.

The kinematics of a set of deep water breaking waves were studied experimentally in the 120-foot towing basin. This type of wave is used to determine the resistance of ship models to capsizing. To produce a set of scaled spilling and plunging breakers, a computer program was written to scale the wavemaker drive signal for a given wave type to various mean frequencies. The amplitude of the signal was adjusted so that for each breaker type the wave broke at the same fraction of the theoretical convergence position calculated from Longuet-Higgins linear theory. The wave profiles were measured at various positions prior to breaking with a set of resistance wave height probes. The profiles from adjacent probes were used to obtain the speed of the crests, troughs, and zero crossings of the waves.

Several geometric parameters seem to correlate with the breaker type. These include the wave asymmetry parameters described by Myrhaug and Kjeldsen (1983), a Froude number based on the speed of the wave crest and the crest-to-preceeding trough wave height, and the ratio of the speed of the crest just prior to breaking divided by the speed of a linear wave with the same mean period as the breaker. The measured parameters show that the method of scaling a given breaker type to various frequencies was successful. It is hoped that these results can suggest which sea state parameters should be measured from actual sea records taken from wave probe arrays in order to predict the probability of breaking waves near an array.

JOHNSON, Bruce, Professor, and Steven ENZINGER, Naval Architect Technician, "Inexpensive Side Beaches for Improving Calm Water Testing Efficiency," Proceedings of the Eighteenth International Towing Tank Conference, Kobe, Japan, October 1987, pp. 146-148.

For those tanks in which side beaches were not originally installed, there exists a relatively inexpensive method for reducing the waiting time

between runs. It consists of installing swimming lane markers/wave dampers on one side of the tank. This concept was originally developed by Professor S. Takezawa while researching the wave absorbing qualities of "course ropes" for swimming competitions. Swimming lane markers are very efficient wave absorbers as they have sharp edges to convert wave energy into turbulent energy. Examples of wave time histories illustrate how slowly the model wave energy decays without a side beach, and how rapidly it decays with swimming lane markers installed on one side of the tank. Based on the U.S. Naval Academy results, the new Canadian tank at St. Johns, Newfoundland, installed swimming lane markers on both sides of the tank, and reported that their research efficiency increased by more than a factor of two.

MCCORMICK, Michael E., Professor, co-editor, Proceedings of Utilization of Ocean Waves. New York: American Society of Civil Engineers, 1987.

Within the past few years the exploitation of ocean waves has become a reality. This has been due to the research and development efforts in a number of the developed countries bordering on the world's oceans. These efforts have been in both the scientific and the technological areas, and, as a result, the technological advances have kept pace with the scientific advances. These advances have been well utilized in Japan, the United Kingdom, and Norway where commercialization of ocean wave energy systems is now underway.

Of the many methods of converting the energy of ocean waves into more usable forms, the pneumatic technique has been chosen by a number of countries for their national programs. This ASCE/NSF Specialty Conference is devoted to the scientific and technological advances in pneumatic wave energy conversion and associated technologies such as energy transfer, storage, and integration. Several at-sea national programs involving pneumatic systems are described. So as to recognize the potentials of other non-pneumatic techniques, a number of seminar papers are also included. The proceedings resulting from the Symposium do not include all of the papers presented. The selection of the proceedings papers is done to give the reader a good overall idea of the advances in pneumatic wave energy.

## NAVAL SYSTEMS ENGINEERING

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MCCORMICK, Michael E., Professor, co-author, "Converted Wave Energy Transmission, Storage, and Integration," Proceedings of Utilization of Ocean Waves Symposium, American Society of Civil Engineers, 1987, pp. 103-126.

Results of a number of full-scale studies of transmission, storage, and integration of electricity resulting from wave energy conversion are discussed. These studies involved the floating system, KAIMEI, and the fixed systems at Sanze, Japan. The undersea transmission of electricity by an FRP armored cable over a period of several years was a success. After seven years exposure to saltwater, no alteration of the transmission capability of the cable was noted. Fluctuations in the electrical output were successfully smoothed by the flywheel effect of the turbine in conjunction with an AC-DC-AC conversion system, allowing the electricity produced by an induction generator to be transmitted to the local power grid. For smaller application of wave power, a lead-acid battery system in parallel with a Diesel-powered generator was found to be most suitable. This system of storage and integration could be used on remote islands where the power demand is relatively low. Finally, the use of dampertanks for energy smoothing was found to be ineffective.

MCCORMICK, Michael E., Professor, co-author, "Experiences in Pneumatic Wave Energy Conversion in Japan," Proceedings of Utilization of Ocean Waves Symposium, American Society of Civil Engineers, 1987, pp. 1-33.

Several prototype and model studies of pneumatic wave energy conversion systems are discussed, including those of the floating platform KAIMEI, the fixed system at Sanze, and the new system called the Backward Bent Duct Buoy (BBDB). Although the overall conversion efficiency of the KAIMEI system in converting wave energy to pneumatic energy was poor, the subsequent conversion of the pneumatic energy to electrical energy by the impulse turbines, the McCormick turbine, and the Wells turbine was excellent. The overall performance of the fixed system at Sanze was far superior to that of

the KAIMEI, since there is no phase cancellation of the relative motions of the internal wave and the capture chamber. The fixed system appears to be most economical in supplying power to near mainland islands. The floating system can be dramatically improved by using the BBDB concept. Test results indicate that very high overall efficiencies can be attained by the BBDB. This system will be the most economical pneumatic wave energy conversion system for the island communities.

MCCORMICK, Michael E., Professor, "Hydrodynamic Coefficients of a Monolithic Circular Off-shore Structure," Division of Engineering and Weapons Report EW-18-86, Revised, September 1987.

Expressions for both the rectilinear and rotational inertial and damping coefficients for a circular monolithic tower of uniform radius are derived. The analysis matches the fluid velocity, derived from potential theory, with the structural velocity in sway. That is, the motions of the tower are assumed to be in a vertical plane. The analysis is then applied to a tower composed of (lumped-mass) elements, where the expressions for the added-mass and damping coefficients are shown to be functions of wave number. The added-mass is shown to be a product of two wave systems: a traveling wave system, which is responsible for the radiation damping, and a standing wave system, called the evanescent system, which is attached to the structure.

The added-mass of the evanescent system is negative for small wave numbers, while that of the traveling waves is positive. The negative sign simply means that the inertial force of the evanescent waves is 180° out of the phase with that of the traveling system. Furthermore, it is shown that the contributions of the two wave systems to the total added-mass of the structure counteract each other, resulting in a total added-mass which varies gradually with the wave number.

Finally, the analysis is applied to an experiment, and results of the analysis and the experiment are found to agree rather well.

## NAVAL SYSTEMS ENGINEERING

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NUCKOLS, Marshall L., Assistant Professor, co-author, "Thermal Behavior of Electro-Mechanical Cables for ROV Applications," Proceedings of Remotely Operated Vehicles 88, Bergen Norway, 17-20 April 1988.

Recent trends in the Remotely Operated Vehicles (ROV) industry have been toward deeper and more powerful vehicles. Because of the critical role of the umbilical cable in these systems, efforts have been made to optimize cable design and reduce cable diameter. Unfortunately, the design goals of more power and smaller cable diameter can lead to cables with high resistive heat loss. If the vehicle is operated with a significant quantity of cable wrapped on the winch drum, overheating and cable damage may occur. This paper describes a computer model developed to evaluate overheating concerns and to assist in cable design. A generalized, finite difference analysis technique is used, which provides two-dimensional solutions for cable reels having a variable number of layers, turns per layer, cooling methods, cable resistive heating levels, and ambient conditions. The analysis technique is particularly beneficial in conducting cable sensitivity analyses, which identify the critical design and environmental parameters related to cable core temperature. The approach provides greater accuracy and versatility than a simple closed-form solution, and helps the designer to specify acceptable cable designs.

NUCKOLS, Marshall L., Assistant Professor, "Analysis Efforts for the Conventional Dive System, Volume 3," Division of Engineering and Weapons Report EW-9-87, August 1987.

This report is part of the continued research and development effort to improve and modernize the U.S. Navy Conventional Dive System EX 19-1.

TUTTLE, Kenneth L., Associate Professor, Editor, "Marine Diesel Technology, State-of-the-Art," Division of Engineering and Weapons Report EW-4-87, July 1987.

This report contains fourteen separate papers written by marine engineers about marine diesels. Engine types and sizes represent a wide range of engines in use. A substantial amount of information has been compiled for each of the different models.

The authors placed greatest emphasis on including the most basic information such as size, configuration, strokes, turbocharging, power rating, and speed range. However, information on materials, cost, reliability, and users will often be included.

The topics covered include engines for generators or other auxiliaries, boat propulsion, small ship propulsion and large ship propulsion. High, medium, and low speed diesel engines are represented. In addition, papers discussing fuels, problems pertaining to diesels, and ways of improving diesel engines have been presented. For general background, the first paper deals with usage of marine diesels, historical, current and future.

WHITE, Gregory J., Assistant Professor, co-author, "A Reliability-Conditioned Approach for the Fatigue Design of Marine Structures," Proceedings of the 1987 Marine Structures Reliability Symposium, Society of Naval Architects and Marine Engineers, SY-23, October 1987, pp. 99-114.

One of the areas of marine structural design which could benefit greatly from introducing reliability-based design methods is the design against fatigue failure. Recently, the authors have introduced a new reliability-based design method for fatigue. That method is based on the recently developed Reliability-Conditioned (RC) method and the Load and Resistance Factor Design (LRFD) code format. The approach utilizes a probabilistic treatment of available S-N fatigue data to generate partial safety factors for use in a simple design equation.

In this paper, the Reliability-Conditioned fatigue design approach is further discussed and demonstrated with practical examples. In particular, the means for choosing the "most likely failure point," and thus the partial safety factors for the LRFD format, is further detailed. The development of a probability density function for the equivalent constant amplitude stress ranges from the existing stress records of full scale trials is also shown. This development is similar to that currently being investigated under the auspices of the American Association of State Highway and Transportation Officials (ASSHTO) for estimating fatigue design loads of steel highway bridges. And finally, the means by which the Reliability-Conditioned approach could be implemented in a design code and calibrated to that code is illustrated.

## Presentations

COMPTON, Roger H., Professor, "Seakeeping 1987," A series of five three-hour lectures, U.S. Coast Guard Research and Development Center, Groton, Connecticut, 15-19 June 1987.

JOHNSON, Bruce, Professor, "The Kinematics of Deep Water Breaking Waves," IAHR Seminar on Wave Analysis and Generation in Laboratory Basins, Lausanne, Switzerland, 2 September 1987.

JOHNSON, Bruce, Professor, "Inexpensive Side Beaches for Improving Calm Water Testing Efficiency," Eighteenth International Towing Tank Conference, Kobe, Japan, 22 October 1987.

JOHNSON, Bruce, Professor, "Hydro-Numeric Design at the U.S. Naval Academy," Chesapeake Section of the Society of Naval Architects and Marine Engineers, Arlington, Virginia, 24 February 1988.

KRIEBEL, David L., Assistant Professor, "Storm Erosion and Sea Level Rise Considerations in Beach Nourishment, Beach Technology 1988 Conference, Gainesville, Florida, 12 March 1988.

LERCHBACKER, Alan B. Lieutenant Commander, USN, "Challenger Space Shuttle Recovery Operations, U.S. Space Command, Dahlgren, Virginia, 7 October 1987.

LANGAN, Thomas J., Associate Professor, "Spreadsheet Applications in Computer-Aided Design," First International Conference on Industrial and Applied Mathematics, Paris, France, 29 June 1987.

MCCORMICK, Michael E., Professor, "A Four-Year History of the NAVFAC Professorship at the U.S. Naval Academy," Naval Civil Engineering Laboratory, Port Hueneme, California, 4 October 1988.

NELSON, Martin E., Professor, "Performing Power Plant Reliability Analysis With EADS Data on a Personal Computer," NERC-EADS Computer Users Workshop, Savannah Georgia, 13 August 1987.

NUCKOLS, Marshall L., Assistant Professor, "Thermal Behavior of Electro-Mechanical Cables in ROV Applications," Remotely Operated Vehicles 88, Bergen, Norway, 17 April 1988.

TUTTLE, Kenneth L., Associate Professor, "Saving Energy in the Automobile," Rotary Club, Mount Carmel, Maryland, 11 May 1988.

TUTTLE, Kenneth L., Associate Professor, "Combustion-Generated Particulate Emissions," Severn Technical Society Awards Committee, Annapolis, Maryland, 15 July 1987.

WHITE, Gregory J., Assistant Professor, "A Reliability-Conditioned Approach for the Fatigue Design of Marine Structures," 1987 Marine Structural Reliability Symposium, Arlington, Virginia, 6 October 1987.



# Weapons and Systems Engineering

Professor E. Eugene Mitchell  
Chairman

Research within the Weapons and Systems Engineering Department provided the faculty an environment for continued professional growth and the opportunity to remain current in today's rapidly advancing systems technology. Additionally, every graduating Systems Engineering major participated in independent research, design, and development projects which reinforced the essential interface between academics and practical application.

Every faculty member, both civilian and military, participated in independent research directed at solving current U.S. Navy problems or in support of the midshipmen research programs. Faculty research areas included radiation effects on integrated circuits, modeling and simulation of mechanical systems, dynamic modeling of gas turbines, and air blast overpressure effects on turbine engines.

Again this year, emphasis has been placed on the faculty-midshipman relationship during the student independent research course. Each midshipman was assigned both an administrative and a technical adviser. These advisers not only provide support of a technical nature, but also emphasize planning, schedule development, and oral and written presentations. Thus, the student is introduced to all aspects of the research process. Typical examples of the forty-five midshipmen research topics included optical scanning systems, robotic systems, energy control systems, tracking systems, voice recognition systems, and analog and digital control systems.



Funding for research activities has been available from multiple sources including grants and contracts from various federal agencies and naval laboratories as well as funding support from within the Naval Academy. This year's sponsors included the David Taylor Research Center and the Naval Research Laboratory.

# Sponsored Research

## Reduced Complexity Mathematical Models

Researcher: Associate Professor Thomas E. Bechert

Sponsor: David Taylor Research Center,  
Annapolis Laboratory

The purpose of this project is to develop techniques for obtaining mathematical models of subsystem interconnections using a degree of complexity which is appropriate for the analysis or computer simulation being conducted. It is assumed that a detailed model is available for each subsystem. The coupling effects of interconnecting these subsystems generally result in new dynamic modes of operation. The characteristic speeds of some of these resulting dynamic modes may be outside the range of interest for a particular investigation. In this event, computation and conceptual advantages may be obtained by use of a reduced order mathematical model which eliminates these unwanted modes, while retaining the modes of interest. Furthermore, insight into the coupling effects may result from retention of the models of the individual subsystems instead of subsuming them into one model of the overall interconnection.

This project builds upon the Component Connection Model (CCM) work reported by Wasynczuk and DeCarlo in 1981. That work retained one state model for each individual subsystem's dynamics,

separate and distinct from the algebraic equations which model the interconnection of those subsystems. Using the CCM technique, an investigator may identify which subsystems are most strongly associated with which modes of the composite system by observing the migration of the system's eigenvalues as a connectivity parameter varies from zero to unity. Using singular perturbation techniques, the researcher seeks to quantify the sensitivity of each system mode in response to model-order-reduction of selected subsystems or groups of subsystems. The CCM method is used to identify candidate groups of subsystems for model order reduction. The investigator then observes the migration of the system's eigenvalues as the singular perturbation parameter ( $\mu$ ) varies from unity to zero for the candidate subsystems. Each mode's sensitivity to the candidate model order reduction is then measured by the extent of migration of its eigenvalue. This information is invaluable for determining the adequacy of the mathematical model derived from the candidate model order reduction.

## Tactical Artificial Intelligence Demonstrator (TACAIID)

Researcher: Associate Professor C. George Brockus

Sponsor: Naval Research Laboratory

TACAIID is a derivative of the original Multi-sensor Integration Project initiated at NRL in 1984. Building on the experience derived from previous efforts, this project is focused on the analysis of the functions which seem to be of importance in a tactical system trying to solve a localization problem.

The topography of the undersea environment can be inferred to some extent from current information extracted from sensor data taken real time from the environment. Improvement is needed in this infer-

ence, since the target maintains a large advantage in this area.

The severity of this problem is expanded as the parallelism of the problem increases. It is hoped that Artificial Intelligence techniques can be used to make the solution of the problem more tractable for the person involved.

The principal problem with the project this year was a lack of success in the quest to obtain needed information about the systems involved.

## WEAPONS AND SYSTEMS ENGINEERING

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### Radiation Effects on Integrated Circuits

Researcher: Associate Professor Robert DeMoyer, Jr.  
Sponsor: Naval Research Laboratory, Code 6816

The object of the research is experimentally to determine transient and permanent effects on integrated circuits due to radiation. Experiments are being conducted to measure both dose rate and total dose effects.

Current efforts are focused upon the development of remote computer control techniques designed to

control what originally had been designed to as manual test equipment. The result is the ability to observe degradation of test patterns and of memory access times of parts as they are radiated in inaccessible test cells.

### Development of Software for Use in Systems Engineering Feedback Controls Course

Researcher: Professor E. Eugene Mitchell  
Sponsor: Naval Academy Instructional Development Advisory Committee

The report details the work done on an Instructional Development Project carried out during the Spring Semester, 1987. The majority of the work involved the development of computer programs in a high-level, matrix-oriented language, called Control-C. The programs run on the W&SE VAX. They are interactive, producing graphical results on both terminals and a laser printer.

Programs in classical continuous control include time response, Bode plots, Nyquist plots, root locus, and inverse Laplace. Programs in classical discrete control include Z-transforms, W-transforms, discrete response, and closed-loop sampled data control response.

### Active Vibration Isolation Using a Magnetostrictive Actuator

Researcher: Associate Professor Robert S. Reed  
Sponsor: Naval Surface Weapons Center

A vibrator was constructed using a highly magnetostrictive material. Models were developed and experiments were completed to predict and verify the performance of the vibrator. The magnetostrictive vibrator was placed on a small laboratory vibrator, so that base motion could be added. Accel-

eration feedback was added to reduce the amplification at the mechanical resonance frequency. Tests demonstrated that the mechanical behavior of the vibrator could be successfully controlled using the magnetostrictive actuator.

## Development of Stability/Robustness Considerations for Control System Design with Multiple Input/Multiple Output Plants

Researcher: Midshipman 1/C Daniel J. Hurdle, USN

Adviser: Professor E. Eugene Mitchell

Sponsor: Trident Scholar Program

An investigation into stable, robust control system design with multiple input/multiple output (MIMO) plants is conducted. Stability/robustness is identified as the first and primary source of concern in MIMO control system design and thus is the focus of research. Performance/robustness requirements and the meeting of additional performance specifications are largely left for future research. A design example is presented, however, which incorporates the meeting of certain performance criteria into the overall framework of achieving MIMO stability robustness.

Methods which can be utilized to assess the stability/robustness properties of MIMO nominal plant models without control are developed and identified as the first step in the compensator (or controller) design process. The previously developed Model Based Compensator/Linear Qua-

dramatic Gaussian/Loop Transfer Recovery (MBC/LQG/LTR) method is adopted as the general framework for MIMO compensator design, and numerous computer programs are generated to implement it. These programs are written for use with the engineering software package PC-MATLAB. Original methods are formulated, to be used in conjunction with the MBC/LQG/LTR methodology, which provide the control engineer with the means to design for some measure of stability/robustness in the controlled system. Here, also, computer programs were written to implement theoretical developments. Finally, a standard design process was created using the above methodology for the design and testing of a MIMO control system based upon stability/robustness considerations.

## An Endo-Atmospheric Hypervelocity Intercept System

Researcher: Midshipman 1/C Shawn L. Penrod, USN

Adviser: Associate Professor Jerry W. Watts

Sponsor: Trident Scholar Program

This study examines the feasibility of using clouds of hypervelocity pellets to intercept and disable a generic air target. The Directed Energy Projectile Warhead (DEPW) which accelerates these pellets uses an unconventional design to attain speeds an order of magnitude above those of conventional high-explosive warheads. The DEPW is fitted to a conventional intercept missile to put the target in effective range of the warhead, which then detonates, launching the pellets very much like a hypervelocity shotgun.

An extensive three-dimensional computer simulation was developed using Advanced Computer Simulation Language (ACSL) and FORTRAN. The

program models the terminal homing phase of a missile intercept to evaluate the effectiveness of different guidance laws used to align the warhead with the projected intercept point. After a favorable geometry has been achieved, the warhead is detonated, and the lethality of impact between the target and hypervelocity pellet cloud is evaluated.

Overall effectiveness of this system is shown to depend on the pointing accuracy of the warhead and the firing range. No insurmountable obstacles are foreseen in developing a suitable guidance and aiming algorithm. Also, a valuable tool to evaluate design options has been developed.

# Independent Research

## Scaling the Equations for Polynomial Least Square Curve Fitting

Researcher: Associate Professor C. George Brockus

The matrices associated with the equations used for finding best-fit polynomials, to existing data, in a Least Mean Squares sense, are essentially Vandermonde matrices. Those matrices are notoriously ill conditioned for numerical solutions.

The approach to improve the conditioning of those matrices, and thus to improve the quality of the solutions, is to magnitude scale the equations.

The researcher's previous experience in magnitude scaling, first for analog computer programming and then to improve the conditioning of matrices in general, should help in the search for assistance in this area.

## Spreadsheet Analysis for Surface-to-Air Missile Engagements

Researcher: Visiting Professor W. Richard Vollmar

Analysis of naval surface-to-air missile engagements with hostile missile or aircraft targets provides estimates of outcomes and an approach to identifying the impact of key performance parameters on those outcomes. This paper presents a simplified approach for rapid analysis of these engagements, using a personal computer and com-

mercial spreadsheet software. Its main purpose is to acquaint midshipmen at the Academy with the various types of surface-to-air missile systems and their operation and the influence of various surface-to-air missile system performance parameters on engagement outcomes.



# Design Course Projects

Each Systems Engineering major enrolls in ES402, Systems Engineering Design, the capstone course of the major, during his or her senior year. The student is required to propose, design, construct, test, and evaluate a system, a system of particular interest to individual student researchers. The results of academic year 1987-1988 follow.

Associate Professors Olaf N. Rask and Robert S. Reed provided the course coordination and admin-

istrative effort and were assisted by Associate Professors Thomas E. Bechert, C. George Brockus, Robert DeMoyer, Terrence E. Dwan, Kenneth A. Knowles, Jerry W. Watts and Professor E. Eugene Mitchell, who provided technical and systems design assistance and expertise for the listed design course projects.

## **Gun Positioning System Using Head Movements**

Midshipman 1/C Tammy M. Adams, USN  
Adviser: Lieutenant Stanley H. Shoun, USN

## **Voice-Controlled Prosthetic Device**

Midshipman 1/C Max E. Aguilar, USN  
Adviser: Lieutenant Commander David B. Barrett, USN

## **Model Submarine**

Midshipman 1/C Klaus J. Barboza, USN  
Adviser: Lieutenant Commander Paul W. Bobowiec, USN

## **Guided Rocket**

Midshipman 1/C Walter T. Baugh, USN  
Adviser: Captain Dan Simons, USMC

## **Obstacle-Avoiding Wheeled Vehicle**

Midshipman 1/C Theodore Biggie III, USN  
Adviser: Lieutenant Commander Paul W. Bobowiec, USN

## **Radar Deception Device**

Midshipman 1/C Mark A. Butler, USN  
Adviser: Associate Professor Kenneth A. Knowles

## **Computer Music Note Recognition**

Midshipman 1/C Philip E. Campbell, Jr., USN  
Adviser: Lieutenant Commander Paul W. Bobowiec, USN

## **Message Display Board**

Midshipman 1/C Charles L. Cash, USN  
Adviser: Lieutenant Colonel David W. Diggle, USAF

## **Obstruction-Avoiding Vehicle**

Midshipman 1/C Gordon E. Cole, USN  
Adviser: Lieutenant Commander David O. Drew, USN

## **Light-Guided Card**

Midshipman 1/C Clayton C. Cosby, USN  
Adviser: Lieutenant Colonel David W. Diggle, USAF

## WEAPONS AND SYSTEMS ENGINEERING

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### **Six-Legged Walking Machine**

Midshipman 1/C Brian T. Davis, USN

Adviser: Commander Dennis L. Worley, USN

### **Puzzle Assembling Robot**

Midshipman 1/C Matthew J. Ferrier, USN

Adviser: Lieutenant Commander John H. McKim, USN

### **Special Purpose End Effector**

Midshipman 1/C Leanne K. Fielding, USN

Adviser: Commander Dennis L. Worley, USN

### **Programmable Path All Terrain Vehicle**

Midshipman 1/C Stuart S. Gaudet, USN

Adviser: Lieutenant Commander Paul W. Bobowiec, USN

### **Radar Deception Device**

Midshipman 1/C Donald E. Grady, Jr., USN

Adviser: Lieutenant Commander J. Kevin Callahan, USN

### **Visible Light Tracking Cart**

Midshipman 1/C Edgar A. Green III, USN

Adviser: Lieutenant Commander Peter F. Coste, USN

### **Robotic Tactile Sensor**

Midshipman 1/C Mark B. Guevarra, USN

Adviser: Lieutenant Commander David B. Barrett, USN

### **Robotic Tactile Sensor**

Midshipman 1/C Christopher Harkins, USN

Adviser: Lieutenant Commander J. David Ouellette, USN

### **Light Sensing Cart Positioner**

Midshipman 1/C Jonathan E. Johnson, USN

Adviser: Lieutenant Colonel David W. Diggle, USAF

### **Infrared Intruder Alarm**

Midshipman 1/C David L. Kaufman, USN

Adviser: Lieutenant Commander J. David Ouellette, USN

### **Single Board Computer for Automobile Performance Calculations**

Midshipman 1/C John J. Keeling, USN

Adviser: Lieutenant Commander Christian Q. Ness, USN

### **Wireless Infrared Printer Link**

Midshipman 1/C Kevin K. Kitts, USN

Adviser: Lieutenant Commander John H. McKim, USN

### **Flow Meter (Fuel)**

Midshipman 1/C Charles E. Litchfield, USN

Adviser: Lieutenant Commander J. David Ouellette, USN

### **Navigation System**

Midshipman 1/C Mark P. Maglin, USN

Adviser: Lieutenant Stanley H. Shoun, USN

## WEAPONS AND SYSTEMS ENGINEERING

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### **Optical Control of A Robot Arm**

Midshipman 1/C Michael V. McMahon, USN

Adviser: Lieutenant Commander Joseph P. Gilio, USN

### **Chess-Playing Microbot Robot**

Midshipman 1/C William C. Miller, USN

Adviser: Captain Dan Simons, USMC

### **Auto Volume Control**

Midshipman 1/C Michael J. Munoz, Jr., USN

Adviser: Captain Gregory A. Morrison, USMC

### **Light-Guided Cart**

Midshipman 1/C Albert D. Perpuse, USN

Adviser: Lieutenant Commander David B. Barrett, USN

### **Robotic Diagram Follower**

Midshipman 1/C Ilya A. Poluektov, USN

Adviser: Captain Gregory A. Morrison, USMC

### **Automatic Mine Depth Device**

Midshipman 1/C Michael J. Quilty, USN

Adviser: Lieutenant Commander Joseph P. Gilio, USN

### **I. R. Following Cart**

Midshipman 1/C Bernardo B. Roig, Sr., USN

Adviser: Lieutenant Commander Wesley C. Stanfield, USN

### **Reflected Light Control of a Wheeled Vehicle**

Midshipman 1/C Gregory W. Rouillard, USN

Adviser: Captain Gregory A. Morrison, USMC

### **Firefighting System**

Midshipman 1/C James C. Sarfert, USN

Adviser: Lieutenant Commander Harold H. Cummings, USN

### **Opto-Electronic Burglar Detection System**

Midshipman 1/C Eric J. Savage, USN

Adviser: Lieutenant Commander David O. Drew, USN

### **Coded Security Lock**

Midshipman 1/C Ronald A. Smith, USN

Adviser: Lieutenant Commander Christian Q. Ness, USN

### **Hovercraft**

Midshipman 1/C Bruce A. Stansfill, USN

Adviser: Lieutenant Commander Wesley C. Stanfield, USN

### **Closed-Loop End Effector Control**

Midshipman 1/C Brian E. Street, USN

Adviser: Lieutenant Commander John H. McKim, USN

### **Automated Fire Extinguisher**

Midshipman 1/C Larry W. Strimple II, USN

Adviser: Lieutenant David S. Hilder, USN

## WEAPONS AND SYSTEMS ENGINEERING

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### **Automobile Performance Analyzer**

Midshipman 1/C William D. Taylor, USN

Adviser: Lieutenant Commander Harold H. Cummings, USN

### **Automatic Door Opener**

Midshipman 1/C Steven L. Tiedemann, USN

Adviser: Lieutenant Commander Christian Q. Ness, USN

### **Ultrasonic Range Finder**

Midshipman 1/C Andrew Wannamaker, USN

Adviser: Lieutenant Commander David S. Hilder, USN

### **Design and Construction of Baseball Radar Gun**

Midshipman 1/C Mark M. Wesley, USN

Adviser: Lieutenant Commander Peter F. Coste, USN

### **Six-Legged Walking Machine**

Midshipman 1/C Gerald A. Whitman, Jr., USN

Adviser: Lieutenant Commander Joseph P. Gilio, USN

### **Hand-Activated Fluid Control Device with Force Feedback**

Midshipman 1/C Gregory J. Wild, USN

Adviser: Lieutenant Commander David S. Hilder, USN

### **Artificial Intelligence Automobile Guidance**

Midshipman 1/C Loren L. Wisniewski, USN

Adviser: Commander Dennis L. Worley, USN

# Research Course Projects

## Computer Program to Reduce Signal Flow Graphs by Method of Mason's Gain Theorem

Researcher: Midshipman 2/C Alexander B. Chao, USN

Adviser: Professor E. Eugene Mitchell

Signal flow graphs are frequently favored over block diagrams in the determination of transfer functions. The favored technique used to reduce these graphs is Mason's theorem. However, in applying this theorem, care is needed to check that no loops or forward paths have been missed in the process. Also, the algebra involved often becomes tedious and lends way to human error. One intention of the present work is to avoid such consequences by the use of a computer algorithm. The researcher concentrated on the design of a foolproof algorithm capable of simulating all the steps involved in utilizing Mason's theorem. Such a program would serve both as an analytical and educational tool. The problem involved with any branch sorting technique lies in the time and memory parameter requirements available. The resulting algorithm

avoided such pitfalls by the use of (1) a search-while-scan technique which minimized memory requirements and (2) a parallel-branch search technique, which scanned for the shortest path between any two points. The result is a user-friendly graphical program which provides for the entry of the skeleton of a signal flow graph to be solved. The program then computes all forward paths and loops and applies Mason's gain rule. The user is then prompted for the Laplace transform transmittances associated with each path in the system. The computer-generated result is a transfer function for output/input in the form of  $G(s)/H(s)$  between any two user specified nodes. The most economical method for reducing the final transfer function into simplest terms is currently under development.

## Closed-Loop Control of the Microbot Robot

Researcher: Midshipman 1/C Brian E. Street, USN

Adviser: Associate Professor Kenneth A. Knowles

The design of an industrial robot must be optimized for accuracy, speed, repeatability, and flexibility. Of these criteria, accuracy is often the most important. The accuracy of a robot arm is often limited by the difference between the physical arm and the controller's internal mathematical model of the arm. To be complete, this internal mathematical model must not only describe the ideal operation of the robot, it must also account for external error sources. In many primitive robot arms, like the Microbot, open-loop stepper motor drives which actuate the manipulator, introduce additional positioning errors due to torque-induced pole slippage. The historical solution to the accuracy problem has been to incorporate position feedback into the joints of the manipulator, and then to make the overall robot as rigid and massive as possible in order to minimize elastic deformation errors. Such remedies have led to oversized, energy inefficient

industrial robots.

The researcher concentrated on developing a suitable end effector direct position feedback sensing system which could be used to place accurately the robot's handling device, independent of load or externally-caused configuration deformations which would lead to positioning errors. The use of a three-point thread harness connected between the end effector wrist and three self-reeling potentiometers located around the periphery of the robot's work space provided direct spatial position information to the control computer to permit real time compensation of positional deviations, irrespective of their causes. A prototype laboratory system was constructed using electrically torqued potentiometers. Preliminary results verified the effectiveness of the basic method, and a more refined system is currently under development.

## Hand-Actuated Fluid Control Device with Proportional Force Feedback

Researcher: Midshipman 1/C Gregory J. Wild, USN  
Adviser: Associate Professor Kenneth A. Knowles

Direct hand-actuated devices (valves) are used extensively to provide the control for the power pistons in fluid (pneumatic and hydraulic) systems. In many cases, extremely large and potentially hazardous forces are developed by such positioning systems without the operator being aware of this condition. By providing a feedback force to the operator which is proportional to the power piston force, undesirable consequences can be minimized.

The researcher sought to design and develop a reliable and effective method of providing pro-

portional force feedback to the control valve actuating handle. Initially, a single-axis prototype hydraulic positioning system was developed. Several different approaches were investigated, with a low-pressure pneumatic system being adopted. A three-cylinder pneumatically-powered hydraulic power pack was developed to power the bench test systems under investigation. The results obtained verified the suitability of the prototype system, and an improved multi-axis system was then developed.

## Sample Expert System in Turbo Prolog

Researcher: Midshipman 1/C Loren L. Wisniewski, USN  
Adviser: Associate Professor Kenneth A. Knowles

One of the most potentially useful areas in the ubiquitous realm of Artificial Intelligence is one dealing with Expert Systems. Expert Systems consist of computer programs which are able to incorporate the knowledge and experience of recognized experts in a given area to permit them to perform in an improved manner. The more advanced expert systems are able to evaluate their own performance and modify their knowledge base (i.e., "learn") in order to improve their performance. Because of its inherent ability to perform backtracking and tree searches, and the fact that it can usually be implemented on an ordinary computer, Prolog has been used to construct numerous expert systems.

This researcher tried to build from scratch a simple game-playing expert system using the subset

language Turbo Prolog. In the process, Turbo Prolog was evaluated with respect to ease of learning and usefulness in implementing simple expert systems suitable for student projects. A basic Tic-Tac-Toe game was developed in Turbo Prolog which could be provided with a set of user-defined heuristic rules. Turbo Prolog turned out to be relatively easy to learn, but the development of the expert system was tedious. The preliminary results obtained from this research suggest that a more efficient way to gain expert system expertise might be to utilize one of several commercial programs which act as end user "shells" to permit rapid compilation of expert knowledge data into expert systems. This approach is currently under investigation.

## Publications

BROCKUS, C. George, Associate Professor, "Magnitude Scaling to Improve Conditioning," *Modeling and Simulation*, Instrument Society of America, 18 (November 1987), 1601-1604.

The objective of scaling simultaneous equations is to obtain solution estimates with improved numerical accuracy. Extra benefits accrue, for example, in the determination of controllability and observability, when the determinations for these decisions become better defined with improved sets of eigenvectors. Poor conditioning can arise through widely spread sets of eigenvalues, or from skewed sets of eigenvectors. The scaling technique put forth here improves conditioning for problems of the latter type. This work is based on work done previously for estimating scale factors for differential equations in state space form. That work was useful for engineers involved with the use of analog computers for finding the solutions of differential equations through simulation.

DEMOYER, Robert, Jr., Associate Professor, "MOSAID SRT-1 Tests of Honeywell 8K x 8 and 2K x 8 Static RAM's," Division of Engineering and Weapons Report EW-13-87, (October 1987).

This report summarizes the testing of Honeywell hardened 2K x 8 and 8K x 8 static RAM's using a specially modified MOSAID SRT-1 RAM tester. The modification of the tester permits, under computer control, the inference of read access time. An interface board makes it possible to infer radiation induced shifts in the logic levels of both address and control lines. Typical results are shown. Included are both computer-generated plots and oscilloscope waveforms which aid in the interpretation of the plots.

DWAN, Terrence E., Associate Professor, co-author, "Modeling and Identification of Multi-variable High-Performance Gas Turbine Engines for Real-Time System Simulation, Control Design, and Analysis," *Proceedings of the Nineteenth Annual Pittsburgh Conference on Modeling and Simulation*, Pittsburgh, Pennsylvania, May 1988, pp. 617-624.

Autoregressive least squares identification is used to gain insight for the formulation of simplified analytical models of a multivariable, twin spool gas turbine engine. This paper focuses on an example of the use of identification to examine an engine model structure and parameters to be used in the development of system simulations, real time simulations, and control design.

MITCHELL, E. Eugene, Professor, and Robert DEMOYER, Jr., Associate Professor, "Development of Software for Use in Systems Engineering Feedback Controls Course," Division of Engineering and Weapons Report EW-1-88, (January 1988).

For the past fifteen years, control system computer-wide design programs have been developed by Weapons and Systems Engineering faculty members. The programs, written in FORTRAN and BASIC, resided on NATS. The work is described in this set of programs. The programs on NATS have been installed on the Weapons and Systems Engineering VAX 11/785. A major part of the effort was to develop new control system design programs written under the Control-C environment. This set of programs, described here in detail, are matrix oriented, and feature easy and consistent data entry, as well as high quality graphical output. All of this work directly applies to an ongoing shift from Control-C to MATLAB, which runs both on the VAX and on Zenith Z-48 microcomputers.

RASK, Olaf N., Associate Professor, and David A. ROBINSON, Ensign, USN, "Graphite as an Imbedded Strain Gauge Material," *Society for the Advancement of Material and Processing Engineering*, 24, 1 (January - February 1988), 52.

Graphite epoxy composite material offers a unique window into its state of strain or structural integrity. Since unidirectional graphite epoxy composites possess an electrical resistance in the direction of the fibers over four orders of magnitude less than the electrical resistance across the fibers, electrical resistance measurements can be accurately correlated with strain in the fibers. Moreover, in the case of internal damage in which the graphite fibers are broken, the electrical resistance measurements can serve as a clear indicator of internal damage which might not be otherwise apparent. The actual values of strain sensitivity,  $S_A$ , as calculated from the resistance measurements, varied between 1.2 and 1.8. These values depended critically upon the exact geometry of each hand laid up specimen, and with more control over the specimens in the future, a more accurate value for  $S_A$  for this material can be expected. However, for a single, typical specimen, the apparent value of  $S_A$  stayed constant to within  $\pm 4\%$  over a wide range of strain, indicating that with calibration the graphite can serve as its own strain gauge with the same accuracy.

## WEAPONS AND SYSTEMS ENGINEERING

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REED, Robert S., Associate Professor, "Active Vibration Isolation Using a Magnetostrictive Actuator," *Instrument Society of American*, 19, 5 (May 1988), 2087-2091.

A vibrator was constructed using a highly magnetostrictive material. Models were developed and experiments were completed to predict and verify the performance of the vibrator. The magnetostrictive vibrator was placed on a small laboratory vibrator so that base motion could be input. Acceleration feedback was added to reduce the amplification at the mechanical resonance frequency. Test demonstrated that the mechanical behavior of the vibrator could be successfully controlled using the magnetostrictive actuator.

VOLLMAR, W. Richard, Visiting Professor, "Spreadsheet Analysis for Surface-to-Air Missile Engagements," *Proceedings of the Nineteenth Annual Pittsburgh Conference on Modeling and Simulation*, Pittsburgh, Pennsylvania, (May 1988).

Analysis of naval surface-to-air missile engagements with hostile missile or aircraft targets provides estimates of outcomes and an approach to identi-

fying the impact of key performance parameters on those outcomes. This paper presents a simplified approach for rapid analysis of these engagements using a personal computer and commercial spreadsheet software. Its main purpose is to acquaint midshipmen at the Academy with the various types of surface-to-air missile systems, their operation and the influence of various surface-to-air missile system performance parameters on engagement outcomes.

WATTS, Jerry W., Associate Professor, "Dynamic Simulation of a Gas Turbine Engine Using ACSL," *Proceedings of the Nineteenth Annual Pittsburgh Conference on Modeling and Simulation*, Pittsburgh, Pennsylvania, 19 (May 1988), 631-635.

The gas turbine engine modeled in this study has a rated power of 2000 kw and is single shaft; i.e., the compressor, turbine, and load are all on the same shaft and turn at the same speed. There are many applications which require the shaft speed to be held constant. The control for such a system adjusts fuel flow under the condition of changing load to maintain this constant speed. This is a computer model of this single shaft configuration and the control volumes used.



## Presentations

BECHERT, Thomas E., Associate Professor, "Reduced Order Modeling of Interconnected Subsystems," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

BROCKUS, C. George, Associate Professor, "Scaling the Equations for Polynomial Least Mean Squares Curve Fitting," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

DWAN, Terrence E., Associate Professor, "Modeling and Identification of Multivariable High-Performance Gas Turbine Engines for Real-Time System Simulation, Control Design, and Analysis," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

KNOWLES, Kenneth A., Associate Professor, "A Technique for Evaluating Hybrid System Performance Using Digital Simulations," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

REED, Robert S., Associate Professor, "Active Vibration Isolation Using a Magnetostrictive Actuator," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

VOLLMAR, W. Richard, Visiting Professor, "Spreadsheet Analysis for Surface-to-Air Missile Engagements," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

WATTS, Jerry W., Associate Professor, "Dynamic Simulation of a Gas Turbine Engine Using ACSL," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5 May 1988.

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Division of  
English and History



DEPARTMENT OF

# English

Lieutenant Colonel Laurence W. Mazzeno, USA  
Chairman

In 1987-1988 the English Department faculty undertook and completed a host of sponsored and independent projects, and continued to publish their work and present papers energetically.

Sponsored research included projects in career studies, the psychology of language, critical investigations of medieval and modern poetry, studies in the modern novel, biography, and an extensive evaluation of computer software for instruction in composition and literature. Independent research was similarly diversified, and marked by original study and "start-up" projects by several faculty members. These notably included a history of drama at the Naval Academy, an edition of the journals of a former secretary of the Navy, and at least four book-length studies on various topics that are either in manuscript or awaiting scheduled publication.

This same group of scholars has supervised midshipmen in over a dozen research projects, some of which extended the body of knowledge on prominent authors or traditional topics, some of which broke new ground or produced original creative writing.

To a large extent, the publication record of the English Department faculty this reporting period grows out of previous research directly or indirectly supported by the Naval Academy and external sponsors. While the 15 articles and review essays, 2 edited books, 17 reference entries, and bibliographic and journal editing work constitute a worthy group accomplishment, the summarized research herein augurs an even more productive year in 1988-1989.

The faculty continued active in dialogue among colleagues at large and in presentations to professional gatherings during the academic year, as



implicit in the 39 presentations listed, a total constituting roughly an average of at least one presentation per member of a relatively large and certainly prolific group of scholar-researchers and teachers--whose consistent growth in professional expertise underwrites the English program and the overall mission of the institution.

## Sponsored Research

### **Edward Young: An Eighteenth-Century Literary Career**

Researcher: Assistant Professor Stephen N. Brown  
Sponsor: Naval Academy Research Council (OMN)

Edward Young (1683-1765) was a literary figure of greater stature in eighteenth-century England than modern scholarship has recognized. In a literary career spanning half a century (1710-1762), Young distinguished himself in tragedy, verse satire, meditative-religious verse, and the prose essay; his productions at times reflected, but often anticipated, his century's well-noted changes in literary taste. When Alexander Pope died in 1744, Young, in the midst of publishing his vastly popular and influential poem *Night Thoughts* (1742-1746) and at the height of his contemporary reputation, was justly considered by many the great poet's successor. His career, while not as distinguished as that of another versatile talent of the age, Henry Fielding, is as

representative of the diversity of eighteenth-century literary life.

This project takes Young's career itself as an object of inquiry, aiming at a comprehensive description of how the poet conceived his own career, how his life took shape around his artistic productions. The description takes account of social, political, and personal pressures bearing upon that production. Because Young's achievement was so diverse, it touches many aspects of eighteenth-century culture; this study thus offers a fresher view of the period than that afforded through studies of major figures such as Pope or Fielding.

### **Language in Nineteenth Century British Poetry**

Researcher: Assistant Professor Laura Claridge  
Sponsor: Naval Academy Research Council (OMN)

In this ongoing project the researcher continues work on a Lacanian analysis of Wordsworth, Shelley, and Byron, studying the ways in which unconscious desire motivates even the structure of British Romantic poetry. By using the revised Freud of Jacques Lacan, the researcher explores the

intersection of language with sexuality and death. Thus the investigation seeks a better understanding of the poetics which underwrites what most scholars of the period regard as a particular homogeneity of Romantic desire.

### **A Critical Study of May Swenson's In Other Words**

Researcher: Associate Professor Eileen Tess Johnston  
Sponsor: Naval Academy Research Council (OMN)

As one of the most gifted and accomplished American poets writing today, May Swenson has received over the past thirty years acclaim from reviewers and fellow poets and numerous awards, grants, and fellowships. Of the nine volumes of poetry she has written since 1954, her most recent collection, *In Other Words* (1987), has been widely praised as her finest achievement.

Although Swenson is, in the poet and critic John Hollander's words, "one of our few unquestionably major poets," and despite her solid reputation, her

work has not received the critical study it deserves in academic and scholarly journals and books.

The researcher's work will focus on Swenson's *In Other Words*, investigating both the matter and the manner of the poems in this collection. Swenson has been called by critic Ann Stafford "the poet of the perceptible"; these forty-three poems record moments of intense and joyful observation; obliquely or directly, they reflect upon the nature of seeing. For Swenson, "Vision, potent, regenerative, lives in the bodies of words."

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## The Genesis of Moby Dick

Researcher: Assistant Professor Robert D. Madison  
Sponsor: Naval Academy Research Council (OMN)

In studying the writing of fiction by a major author, one hopes to answer many questions about the literary process in general. With a writer like Melville, however, more questions are likely to be raised than answered. This was certainly the case with this project, which was undertaken at Yale University's Beinecke Rare Book Library, the Massachusetts Historical Society, and Harvard's Houghton Library. At Yale the study primarily was aimed at a collateral problem, the authorship of J. F. Cooper's *Ned Myers*. Working with Hugh Egan (Ithica College), new methods of biographical

inquiry revealed that all previous accounts of the composition of the book were doubtful. An examination of neglected Yale material also clarified the authorship of Cooper's review of the Somers mutiny case, in which Melville was intensely interested. In Massachusetts, the research focussed on the papers of Richard Henry Dana, Jr. and on the marginalia in Melville's copy of *Natural History of the Sperm Whale*. Some of the results of the research were presented at the American Culture Association's annual meeting under the title "Melville's Cheever and Scoresby's Cheever."

## The Conclusion of Richard Hughes's The Human Predicament

Researcher: Commander Stephen V. Myslinski, USNR  
Sponsor: Naval Academy Research Council (OMN)

Richard Hughes (1900-1976), probably best known for his novels *High Wind in Jamaica*, *In Hazard*, *The Fox in the Attic*, and *The Wooden Shepherdess*, also wrote children's stories, radio and television scripts, short stories, magazine articles, and poetry. After his death, Indiana University's Lilly Library purchased all the Hughes manuscripts. Of most interest are the unpublished chapters of his final, incomplete novel, which was to be the final volume

of *The Human Predicament* trilogy, whose first volumes are *The Fox in the Attic* and *The Wooden Shepherdess*. Known as a slow writer, Hughes had written only twelve chapters, roughly a third of the last novel, before he died. The first two volumes deal with England and Germany during the Weimar Republic and Hitler's rise to power. These volumes suggest that Hughes had outgrown his original play—the proof lies in his notes and manuscripts.

## Orality, Literariness, and The Tail-Rhyme Romance

Researcher: Associate Professor Timothy D. O'Brien  
Sponsor: Naval Academy Research Council (OMN)

The purpose of this project is to use recent developments in critical theory, as well as studies of the transition from an oral to a written culture, as ways of addressing the unrecognized complexity of English tail-rhyme romances composed in the fourteenth century. The plots of these romances are often formless; their characters invariably remain undeveloped; and they just as often lack a unifying theme. But the circumstances of their production are intriguing and worthy of study: these works are produced in an attempt to mimic some original, oral delivery. Thus, their literary status as written texts

with oral authority is complex and highly suggestive, but it has received little attention from medieval scholars. This lack of attention is a result of uninventive critical approaches that are restricted mainly to source study and the search for meaning. An approach that deals more fully than these with the transition from oral to written culture will enable the researcher to complete a substantial essay on one of these romances, *Sir Launfal*, and compose also an extended paper on the entire group of romances.

## A Biography of William Oliver Stevens

Researcher: Associate Professor Michael P. Parker  
Sponsor: Naval Academy Research Council (OMN)

William Oliver Stevens (1878-1955) ranks as one of the most talented men ever to teach at the U. S. Naval Academy. He was the author of 47 books, including the first textbook on seapower and the best single volume ever written on the city of Annapolis; he was an accomplished artist; he won national recognition as an educator. Stevens's twenty-one-year career at the Naval Academy came to an abrupt end in the summer of 1924, however, when the Superintendent, Rear Admiral Henry B. Wilson, refused to renew his contract. Officially, Stevens was let go for reasons of economy; the full

story, in fact, is a complex fabric that weaves together naval politics, academic freedom, family feuds, and the recurrent controversy over the place of civilian faculty at the Academy. This research, which relies entirely on primary source materials, will result in a biographical study that places Stevens in the educational, cultural, and naval contexts in which he lived and wrote.

This project has already led to an exhibit on Stevens at the Nimitz Library; a full-length study of Stevens's life is in manuscript.

## A Comprehensive Study of Computer Software in English

Researchers: Professor David O. Tomlinson  
and Associate Professor Harriet Bergmann  
Sponsor: Naval Academy Instructional Development Advisory  
Committee

The project is to collect, evaluate, and give written guidance about the use of as many software packages as are available in teaching plebe or freshman English classes. That is, packages teaching basic reading, writing, vocabulary, grammatical and composition skills, as well as those introducing literary genres, will be reviewed. The researchers are considering both commercial and public domain/shareware programs.

In the fall five Anne Arundel County high school students working in the mentorship program will

review those programs selected by the researchers for ease-of-use testing. The reviews of the software packages will be printed and distributed to (1) members of the English Department at the Academy, (2) any interested members of other departments at the Academy (many packages will be applicable to technical writing), and (3) members of regional and state organizations devoted to the teaching of English at the college level.

# Independent Research

## **Chandler, Hawkes, and Narrative Style in The Big Sleep**

Researcher: Associate Professor Neil Berman

Work has recently begun on a critical study of the narrative style in Howard Hawkes's *The Big Sleep*. While the screenplay of Hawkes's film takes great liberties with the plot of Chandler's novel, the premise of this research is that the narrative style of the film achieves the same emotional and psychological effects as the novel. Special emphasis on the use of *mise-en-scene*, framing, lighting, and the revisions in the original screenplay reveal that Hawkes's emphasis on the star system in place at

Warner Brothers in the mid 1940s mitigate against the obvious plot changes in the screenplay, and, indeed, reinforce the thematic concerns of Chandler's novel. The original screenplay, co-authored by William Faulkner, was radically revised by Jules Furthman after the film's original release. An unpublished interview with Leigh Brackett, the other original screenwriter, reveals the extent and intention of these revisions.

## **Pope's Rape of Excess**

Researcher: Assistant Professor Laura Claridge

Alexander Pope's *The Rape of the Lock* has consistently been regarded as a poem that encourages its female protagonist to join the prevailing social order. This researcher instead

argues that Pope addresses the issue of mythical female sexual power, and that the potency of the poem results from his inability to contain the boundaries of female sexuality within his text.

## **The Comic Vision of Robert Hayden**

Researcher: Professor Fred M. Fetrow

One cannot study the poetic canon of Robert Hayden, the first Black poet to occupy the Consultant in Poetry position at the Library of Congress, without perceiving the care and seriousness with which he approached his art. Because Hayden was so committed to the demands he made upon himself, rarely did he allow humor to gleam through the brilliance of his poetry. That omission is unfortunate, because Robert Hayden

had an acute and astute sense of the absurd, and he often revealed his "comic vision" in ways both personal and professional. An understanding of how and when Hayden manifested his sense of humor helps the reader of his poetry better comprehend the sensibility behind the work, and affords the student of modern poetry a refreshing appreciation of one of its most deft practitioners.

## **The Achievement of Robert Peters**

Researcher: Professor Philip K. Jason

Robert Peters is one of the most widely published poets of this generation. His collections of poems and reviews fill many volumes, and most of his work has received a measure of critical acclaim. However, only rarely has he sought or found a major publisher for his work, preferring instead the hospitality of small, usually non-profit presses. Partly as a result of this manner of reaching the

public, partly out of suspicion of the enormous bulk of his work, and partly because of the unusual daring of his enterprises, Peters has been granted only marginal status by literary tastemakers in academe and elsewhere. The present research will explore the nature of Peters's achievement against the background of how literary careers and reputations are established and managed today.

### **David G. Riede's Matthew Arnold and The Betrayal of Language**

Researcher: Associate Professor Eileen Tess Johnston

This review essay of 1500 to 2000 words will appear in the scholarly journal *Modern Philology*. The researcher has been commissioned to analyze Riede's work and compose the essay by Professor Gwin J. Kold of the University of Chicago and co-

editor of *Modern Philology*. Riede's study was published by the University Press of Virginia in 1988, and focusses on Matthew Arnold's attitudes toward language and their manifestation in his essays and poetry.

### **S. S. Van Dine**

Researcher: Associate Professor Eileen Tess Johnston

Commissioned by Salem Press for their forthcoming *Critical Survey of Mystery and Detective Fiction*, a five-volume reference work surveying 350 writers in the genre, this article will focus on the achievement of S. S. Van Dine (a pen name for Willard Huntington Wright). The study will be subdivided into

sections listing the author's principal series and series characters, defining his contribution, giving a biographical sketch, and providing an analysis of his works. A listing of the author's major publications and a brief, unannotated bibliography of critical or biographical works will follow the text.

### **The Creative Writer's Handbook**

Researchers: Professors Philip K. Jason and Allan B. Lefcowitz

*The Creative Writer's Handbook* is to be a textbook for college introductory creative writing courses. The text will isolate such special concerns as research and invention, diction, point of view, journal keeping, major genres, and special technical matters such as manuscript form, word processing,

and editing/revision. The researchers have taken a problem-solving approach, providing the reader with exercises to illustrate choices and techniques in the creative writing process. The book is completed, has been favorably reviewed by the publisher, and will be into production during fall, 1988.

### **Special Issue of The Arnoldian to Commemorate The Centennial of Matthew Arnold's Death**

Researchers: Professor Allan B. Lefcowitz and Lieutenant Colonel Laurence W. Mazzeno, USA

This project involved soliciting, editing, and presenting articles and graphics to make up a 100-page issue of *The Arnoldian* to mark Arnold's death on 15 April 1888. In addition, the researchers had to provide various introductions, design, typeset, and

generally handle all the various details of production for this special issue. The issue is now complete and in the process of being distributed. This project was funded by the Faculty Development Program.

## Henry James: Literary Theory

Researcher: Lieutenant Colonel Laurence W. Mazzeno, USA

This study traces the development of Henry James's theory of fiction, noting how his emphasis on the artistic merits of a work differs from the moralistic theories of many of his contemporaries. The essay focusses on James's own critical writings, notably

"The Art of Fiction" and the Prefaces to the New York Edition of his novels. The completed article will be published in *Critical Survey of Literary Theory* by Salem Press.

## Herman Wouk: A Critical Assessment

Researcher: Lieutenant Colonel Laurence W. Mazzeno, USA

Though he has achieved immense popularity in America and abroad, Herman Wouk has seldom been the subject of serious critical study. This project is designed to culminate in a monograph that examines all of Wouk's major works, focusing

on the novels about World War II, and providing critical assessments of their literary merits and popular appeal. When completed, the volume will be published as part of the Twayne United States Authors series.

## A Concordance to Tennyson's Poetry

Researcher: Lieutenant Colonel Laurence W. Mazzeno, USA

For some time, a new concordance to Tennyson's poetry has been needed. The publication of the second edition of Christopher Ricks's *Poems of Tennyson* make it possible to continue with this project, which was begun in 1980. The new con-

cordance will be computer-generated; data have already been entered, and students and faculty at the University of Western Ontario will be proofreading the text and preparing copy for publication by Cornell University Press.

## Structural Sophistication in the Novels of John Irving

Researcher: Professor Charles J. Nolan, Jr.

The novels of John Irving provide a clear instance of increasing structural sophistication. The last two books especially--*The Hotel New Hampshire* and *The Cider House Rules*--suggest that Irving is in complete control of the architecture of his musings on contemporary life. An examination of the works

in chronological order makes evident Irving's claim to a prominent position among authors of our time.

This project, in its early phases, necessitates a review of the literature and then some further delineation of topic. The result should be a substantive article on Irving.

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## A History of Drama at The U. S. Naval Academy

Researcher: Associate Professor Michael P. Parker

Dramatic performances have formed an essential part of life at the U. S. Naval Academy since 1846, when a production of *The Lady of Lyons* by a troupe of exuberant (and inebriated) midshipmen scandalized Annapolis society. This project charts the history of drama at the Academy over the past 142 years, concentrating particularly on the period after the founding of The Masqueraders in 1907. It traces changes in the types of plays produced; the influence of Broadway and later of the film industry;

the rise of the stage crew and the juice gang; and the fifty-year-long debate over the virtues of actresses versus female impersonators. This history complements the work of Jane McWilliams on drama in eighteenth- and early nineteenth-century Annapolis. In particular, it examines the formative influence exercised by the Academy on the performing arts in the city and considers the ways in which that influence has evolved during this century.

## The Politics of Davenant's Jeffereidos

Researcher: Associate Professor Michael P. Parker

Although highly regarded in the seventeenth century, *Jeffereidos*, Sir William Davenant's mock epic poem on the captivity of Queen Henrietta Maria's dwarf, has routinely been dismissed by modern critics as a peculiar, second-rate production. The disparity in critical reception is largely due to the disappearance of the political context in which the poem was written: few twentieth-century readers are attuned to the complex foreign policy issues and intricate court alignments that Davenant addresses. Briefly stated, *Jeffereidos* was composed at a delicate moment in Anglo-Spanish relations. Ambassadors from Madrid were in London to urge Charles I to conclude his two-year war with Spain, and the king seemed inclined to comply. Henrietta Maria, on the other hand, advocated that Britain forge an offensive alliance with France and pro-

secute the war with Spain more vigorously; Davenant's mock epic champions her arguments. The poet uses the imprisonment of the royal dwarf by Dunkirk pirates to criticize the king's apparent truckling to Spain; the seemingly extraneous details of the piece prove to allude to very real persons and events. This reading of the poem suggests that the Caroline court tolerated a much wider range of political discussion and dissent than historians have hitherto recognized. The study also expands our understanding of the position of court dwarfs, who served as lightning rods for dissatisfaction with the policies of their masters.

An essay based on this research has been accepted for publication in *The Muses Commonweale: Politics and Poetry in Seventeenth-Century England* by the University of Missouri Press in 1988.

## Thomas Carew and The Saxham Masque

Researcher: Associate Professor Michael P. Parker

Thomas Carew wrote a dozen poems for the family of Sir John Crofts of Saxham Parva, but his relationship to the Crofts clan has never been the subject of sustained critical scrutiny. The researcher's discovery of a masque presented by the Crofts for King James I in 1620 or 1621 provides the focus for such a study. The masque is contained in Osborn MS. b 197, now in the Beineke Library at Yale University; the manuscript is a commonplace book compiled by Tobias Alston, a Suffolk neighbor of the Crofts. A preliminary examination of the text

suggests that the masque was composed by Thomas Carew, perhaps in collaboration with members of the family. It is linked thematically with the poem Carew wrote welcoming James to Little Saxham; the verse form and details of diction and syntax all jibe with the poet's style during this period. This study will consist of an edition of the masque; a sustained account of the Crofts family at the Jacobean court; and a critical consideration of the ways in which poets and patrons worked together to attain precise political and social ends.

## Fiction's Inexhaustible Voice: Speech and Writing in Faulkner

Researcher: Professor Stephen M. Ross

This study, now in a manuscript of 435 pages, to be published by the University of Georgia Press in 1989, is both an examination of Faulkner's *oeuvre* and a theoretical study of "voice" in fiction. The four chapters each track a mode of voice, or represented speech and writing. The book includes a study of Faulkner's dialogue and dialect writing (plus a suggested framework for a general "function" theory of represented speech); a new analysis of

Faulkner's portrayals of thought; and an examination of oratory as a discursive practice as well as of Faulkner's relation to Southern oratory. New readings of certain works are also included, though the study is not primarily interpretive, and departs from the majority of books on Faulkner in not being structured primarily on either a text-by-text or a chronological basis.

## The Journals of John Pendleton Kennedy

Researcher: Professor David O. Tomlinson

John Pendleton Kennedy was Secretary of the Navy, a Congressman, a Speaker of the Maryland House of Delegates, the first Provost of the University of Maryland, and a friend of the rich and famous in America and Europe in the mid-nineteenth century. He was also a writer of some note. Louis Rubin, dean of Southern literary scholars, has dubbed Kennedy the best writer of novels in the ante-bellum South.

Kennedy left behind extensive journals dealing both with public affairs and with literature in

America. Only a fraction of the content has come to public attention. This long-term project has making the material of the journals available as its goal. Two presentations delivered this school year called on material from the journals which had not, heretofore, been introduced in public; material from the journals also provided the basis for a scholarly article published recently.

The journals reside in the Peabody Institute in Baltimore.



# Research Course Projects

## A Study of Gerard Manley Hopkins' Sprung Rhythm

Researcher: Midshipman 1/C James R. Campbell, USN  
Adviser: Associate Professor David A. White

In this project the researcher focused on sprung rhythm, the special poetic meter invented by the nineteenth-century British poet Gerard Manley Hopkins to imitate the patterns of speech. After examining the basic guidelines for sprung rhythm as set forth by Hopkins in his writings and by Sister Marcella M. Holloway in *The Prosodic Rhythm of Gerard Manley Hopkins*, the researcher evaluated critical reactions to the technique. One major

question addressed was whether sprung rhythm is actually necessary at all, and, if so, whether Hopkins fully understood the workings of his own invention. On this point the researcher analyzed the opposing views of Harold Whitehall and C. K. Ogden; the effect of sprung rhythm notation on the reader's perception of "The Caged Skylark" was examined in light of the critical controversy.

## Modern Southern Perspectives

Researcher: Midshipman 1/C Timothy B. Cherry, USN  
Adviser: Associate Professor Molly B. Tinsley

This project was built upon "Pearl," a short story written by the researcher the previous semester. After reading material by Peter Taylor and Pat Conroy, the researcher drew upon his own Southern upbringing to produce a view of desegregation couched in terms of a traditional childhood infatuation story. A second work followed, using

less narrative and more dialogue to describe one man's struggle against loneliness in a modern corporate setting. The three-story set deals with childhood, coming of age, and adult perspectives on family, death, and romance. Through regular drafting and revising, the writer learned more about refining short stories for publication.

## Midshipmen on Melville

Researcher: Midshipman 1/C Chad O. Dorr, USN  
Adviser: Assistant Professor Robert D. Madison

This project involved the collection and publication of essays on Herman Melville submitted in a first-semester seminar on the nineteenth-century American author. To realize this goal, the researcher gathered the essays, converted them to a single database, oversaw their major revisions, made other minor but necessary revisions, proofread the page-proofs, and performed other tasks required to prepare the collection for publication. The collection includes essays on Melville's life and works, illus-

trations, and a preface by the researcher. The Melville Society has tentatively agreed to sponsor publication of the collection and distribute it to its members. The approximate initial circulation will be in the neighborhood of 500 copies. In the course of the project the researcher learned about various methods of printing and publication; he also gained a deeper appreciation and knowledge of Melville's works.

## A Family I Call Mine: A Collection

Researcher: Midshipman 1/C Anastasia Kelly, USN  
Adviser: Associate Professor Molly B. Tinsley

This project was an experiment in writing poetry. The researcher began with a selective reading of modern and contemporary American poets Adrienne Rich, Sylvia Plath, and Ellen Bryant Voigt to gather ideas for subject matter as well as to study diverse examples of modern poetic form. A series of poems was then drafted, inspired by the re-

searcher's own family and experience, with the object of capturing individual characters through appropriate choice of image and form. The final product of this process of drafting and revising is a series of twelve "finished" poems entitled "A Family I Call Mine: A Collection."

## Remarks and Occurrences on Board The Frigate UNITED STATES from April 1843 To July 1844

Researchers: Midshipmen 1/C David W. Maxwell, and  
Adriaen M. Morse, Jr., USN  
Adviser: Assistant Professor Robert D. Madison

The journal of William H. Wilcox, currently in the collection of the U.S. Naval Academy Museum, is significant because it records daily events of a voyage participated in by the American author Herman Melville. In transcribing and editing the second volume of this journal, which covers the period when Melville was aboard the United States, the researchers endeavored to satisfy their own curiosity while providing a useful tool for Melville

scholars, especially those whose interest centers on the novelist's fifth book, *White-Jacket*, an account of life on a man-of-war. The researchers have retained as much as possible of the original format while focusing on the narrative portion of the log. Original spellings and other stylistic devices have been retained. The resulting manuscript of one hundred and nine pages will be published on a 5 1/4-inch disk for interested Melvilleans.

## Lifestyle and Folklore in a Catholic Female Cloistered Community

Researcher: Midshipman 1/C Michelle L. Meria  
Adviser: Instructor Carol M. Burke

The researcher worked with a Catholic female religious community with a twofold aim: first, to explore the experience of conducting field work within a closed group of individuals; and second, to collect narratives on different aspects of Catholic folklore. The progress and scope of the project was of necessity limited, and outside research was conducted on weekends only. Given these restraints, the researcher limited her field work to collecting narratives on miraculous occurrences and

on saints and angels. Although she initiated an interview schedule with three types of religious communities (active, semi-cloistered, and cloistered), the author found it necessary to limit her research to a single community, that of the cloistered Franciscan Poor Clares of Perpetual Adoration. The project concluded with a paper analyzing the demands of research of this type of community and collating a number of stories collected in the course of the interviewing sessions.

## The Satire of Evelyn Waugh: A Study in Faith

Researcher: Midshipman 1/C Allen Ormond Mitchell, USN  
Adviser: Associate Professor David A. White

The fiction of Evelyn Waugh is famous for its biting criticism of a shallow, empty society. Of particular note is the way in which Waugh deals with religious faith in his works. A lack of faith is first described as a function of an insubstantial society, and later as the reason for this emptiness. The fulcrum point of this change is Waugh's conversion to Catholicism in 1930. In this project the researcher shows that *A Handful of Dust* and *Edmund Campion* are the central works in which Waugh completely changes his tone. In his subsequent novels he clearly defines his vision and presents his solution: acceptance of

Catholic doctrine. The change is most evident in the fates of his post-conversion characters. Dennis Barlow, the Basil Seal-like protagonist of *The Loved One*, is able to escape a material and phony vision, as is Guy Crouchback in the *Sword of Honor* trilogy. A particularly striking example of this change may be found in *Brideshead Revisited*, in which every single main character accepts faith. Waugh's conversion motivated him to refine this vision further in each subsequent work, and it is possible to trace his development clearly.

## The Use of German Folk Hymns in Bach's St. Matthew Passion

Researcher: Midshipman 1/C Scott A. Wilson, USN  
Adviser: Associate Professor David A. White

In studying Bach's use of German folk hymns in his *St. Matthew Passion*, one particular hymn appears to be the most prominent. Paul Gerhardt's German hymn, "O Haupt voll Blut und Wunden" (1656), which is based on a Hans Leo Hassler melody of 1601, can be heard five times in the *Passion*. Bach presents this hymn in a different key and with a different text each time, thus investing it with a changing meaning throughout the work. By varying

the text of this hymn, which was well known to his audience, the composer is able to evoke a fuller understanding of the *Passion* story. While Bach uses this technique of hymn adaptation to give the *St. Matthew Passion* a rich, distinctly German sound, his underlying motive for writing and arranging any music remains *Soli Deo Gloria*--"the glory of God alone."

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## Publications

ARBUTHNOT, Nancy Prothro, Associate Professor, "Wallace Stevens's 'Things of August,'" *Notes on Modern American Literature*, 10, 2 (1988), article 6.

"Things of August" is a "serial" poem of Stevens's late years, a moving poem about the end of summer and the end of life. Because it is a poem written at the time of several of Steven's acknowledged masterpieces, however, it has been relatively neglected by the critics. This article puts the poem in proper perspective as a powerful but flawed near-masterpiece whose sections do not wholly fit together, but which highlights the great theme--death--of Stevens's last works.

ARBUTHNOT, Nancy Prothro, Associate Professor, "Style and Structure in Wallace Stevens's *The Auroras of Autumn*," *Bucknell Review*, 31, 2 (1988), 133-148.

Stevens has been called an "obscure" poet, but a close study of tonality in his work reveals a good deal that the words themselves do not convey. This article examines the short poems in his last complete volume as a group, discussing the diction and syntax Stevens employs and the emotional effect of such techniques as repetitions of words and phrasal units. The discussion of these matters is never specifically technical, but remains accessible to the general reader.

FLEMING, Bruce E., Assistant Professor, "The Coffee-Grounds of the Labassecourian Housemaids, or Inside and Outside in Literature," *Essays in Literature* (Spring 1988), 103-115.

A passage in Charlotte Bronte's novel *Villette* provides the point of departure for this study of what the author calls "inside" and "outside" in a work of literature: (respectively) that point of view which the author takes as a given, and the point of view the audience to which he/she relates this. The passage in question is one where the English narrator of the novel explains the use of coffee-grounds as a cleaning agent in the city she calls "Labassecour," Brussels; in England, she suggests, tea leaves are used for the same purpose. The article's discussion relates to studies in the audience of texts by contemporary theorists such as Stanley Fish and John Searle.

FLEMING, Bruce E., Assistant Professor, "Do We Need to Know How We Know Who?," *Semiotica*, 66 (1987), 423-429.

This is an article reacting to and reviewing a book in analytic philosophy and knowledge theory entitled *Knowing Who* by Boer and Lycan, published in 1986. Fleming suggests that the analysis of what it means to know someone offered by this book is most fruitfully characterized by its attempt to integrate a component of change into the definition of knowing who, thus permitting the integration of new knowledge into the relation being defined. The reviewer further criticizes the authors for an unduly narrow view of what constitutes such new knowledge, pointing out indicative deficiencies in their view of what constitutes new knowledge regarding characters in fiction.

FLEMING, Bruce E., Assistant Professor, "A Parade on Worden Field," *Washington Dance View*, 7 (Spring 1988), 5-7.

In this analysis of the final dress parade of the fall 1987 season, the author scrutinizes military formations in terms of theater and ritual movement. The article relates the parade to contemporary developments in dance and theater, suggesting that it stands on a theoretical boundary line between what are frequently conceived of as being the separate manifolds of life and art. The essay suggests that art is ultimately defined by a fact of the perceiver's point of view, rather than by any substantial content of the work itself.

FLEMING, Bruce E., Assistant Professor, "On Reading Ruskin," *Magill's Literary Annual 1988*. Englewood Cliffs, New Jersey: Salem Press, 1988, pp. 621-624.

This essay is in response to a book of two prefaces by Marcel Proust to the works of John Ruskin, with notes by Proust and an introduction by Richard Macksey which places the collection under the literary critical rubric of intertextuality, or interdependence of authors--a concern central to the deconstructionist thread of contemporary theory. By focussing on an analysis of reading offered by Proust in one of the prefaces, Fleming suggests that this emphasis on the interdependence between the two authors may be misleading as an approach to Ruskin, and proposes a treatment of the texts in the direction of Emerson rather than that adopted by this edition.

JASON, Philip K., Professor, "The Distinction of Otway and Betterton," *Restoration and 18th Century Theatre Research*, 2 Second Series (Summer 1987), 6-18.

In a period like the English Restoration, plays were written for acting companies, and the style and special skills of the available players informed the imagination of any practical playwright. Thomas Otway composed his works for the players of the Duke's Theatre at Dorset Garden headed by Thomas Betterton. Otway's major works, *The Orphan* and *Venice Preserv'd*, grew out of Otway's grasps of and affinity for the particular manner of Betterton's acting style. Betterton's technique, in turn, came to its full perfection through the challenge of roles that could best reveal it--roles like Jaffier. Subtlety, restraint, and a seeming naturalness were the distinctions of both men, and in *Venice Preserv'd*, Otway was able to modulate the popular heroic style of the day in response to Betterton's unique combination of force and restraint.

JASON, Philip K., Professor, "Dropping Another Veil: Anais Nin's *Henry and June*," *Anais: An International Journal*, 6 (1988), 27-32.

*Henry and June* confirms Nin's own opinion that her diary writing was her major literary achievement. However, it complicates the question of what kind of truth we can expect from such literature and just what the boundaries of the genre are. A posthumous re-editing of Nin's manuscript diaries covering the period from October 1931 to October 1932, this volume overlaps material found in the first published diary volume, brought out in 1966. Obviously, both were selective fashionings, and neither holds the entire "truth" of Nin's life during this period. Taken separately, they create alternative Nines: partial fictions. An examination of this new "unexpurgated" material reveals biographical sources for many of Nin's purported fictions. We discover that the most intimate parts of Nin's life were, until now, more fully revealed in her stories and novels than in her published diaries.

JOHNSTON, Eileen Tess, Associate Professor, "Matthew Arnold," *Great Lives from History: British and Commonwealth Series*, ed. Frank N. Magill. Pasadena, California: Salem Press, 1987, pp. 86-92.

This reference article summarizes the life and describes and assesses the career of Matthew Arnold. One of the finest elegiac poets in the English language, Arnold was also Victorian Bri-

tain's greatest literary and cultural critic. His poetry articulates the problems and feelings of an age that is modern, and much of it is remarkably relevant to twentieth-century society. More than anyone else in the nineteenth century, Arnold helped shape the course of literary studies in the modern university. His cultural and religious criticism has also been very influential. It continues to foster intellectual curiosity, a humanistic outlook, and deep moral awareness. His lucid and urbane style and tone have established him as one of the great masters of English prose.

JOHNSTON, Eileen Tess, Associate Professor, Editor, *The Arnoldian: A Review of Mid-Victorian Culture*; 14, 1 (Winter 1986-87), and 14, 2 (Summer 1987).

These two issues of *The Arnoldian* include articles on Walter Pater, John Ruskin, and several on Matthew Arnold, covering his religious writings, the Arnold memorial in Westminster Abbey, Arnold's view of Shelley, and a summary of Arnold scholarship during 1986-1987. The issues also include sixteen reviews of books dealing with nineteenth-century British literature and thought.

MADISON, Robert D., Assistant Professor, Editorial Associate, *The Piazza Tales in The Writings of Herman Melville*. Evanston: Northwestern University Press, 1987.

*The Piazza Tales* is the ninth volume to appear in the CSE-sponsored *Writings of Herman Melville*. This publishing project is the product of many Melville scholars across the country and provides the best texts available of Melville's writings. The present editor has been involved with the project since 1978, and was named Editorial Associate a few years ago. The next volume due out is the long-awaited *Moby Dick*. The Melville project is run jointly by Northwestern University and the Newberry Library.

MADISON, Robert D., Assistant Professor, Ed., *History of the U. S. Navy*, James F. Cooper. Delmar, New York: Scholars' Facsimiles and Reprints, 1988.

Cooper's *History of the Navy* is a facsimile edition of the abridged and revised 1841 edition. It is buttressed by a hundred pages of introduction and notes, focussing on the process of composition of the book and the process of revision. The Naval History was Cooper's major project and holds significance not only in the development of maritime history, but also in the development of a narrative style by a very important novelist.

## ENGLISH

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MAZZENO, Laurence W., Lieutenant Colonel, USA, "John Updike," *Critical Survey of Poetry Series: Supplement*. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 379-386.

This study of John Updike's poetry focusses on his satiric techniques and provides an assessment of his gifts for writing verse. The author suggests that Updike's long poem *Midpoint* is worthy of critical attention, as are some of his short lyrics; ultimately concluding that Updike's greatest talent is as a writer of fiction.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "John Steinbeck," *Beacham's Popular Fiction Series: American Authors*. Washington, DC: Beacham Publications, 1987, pp. 1465-1475.

In this reference article, Steinbeck's career is briefly summarized. Detailed analysis of three major novels is provided: *The Grapes of Wrath*, *In Dubious Battle*, and *Of Mice and Men*.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "Nikos Kazantzakis," *Beacham's Popular Fiction Series: Foreign Authors*. Washington, DC: Beacham Publications, 1987, pp. 819-826.

This reference article provides a brief summary of Kazantzakis' career, focusing on his work as a novelist. The article also contains detailed analysis of three novels: *Zorba the Greek*, *Freedom or Death*, and *The Last Temptation of Christ*.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "John Ruskin," *Great Lives from History: British and Commonwealth Series*. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 2232-2237.

This article, part of a multi-volume set focusing on the lives of major British figures, summarizes Ruskin's career and highlights his contributions to art criticism, architecture, and social criticism.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "William Ewart Gladstone," *Great Lives from History: British and Commonwealth Series*. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 1141-1146.

This reference article provides a review of the career of the most famous British Prime Minister of the nineteenth century. A summary of Gladstone's major contributions to British political thought and activity is highlighted by a discussion of his efforts to pass the Irish Home Rule Bill.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "Frederick Denison Maurice," *Great Lives from History: British and Commonwealth Series*. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 1825-1830.

The major accomplishments of one of the most influential religious figures of the nineteenth century are highlighted in this reference article. Maurice's involvement with the Broad Church movement, and his efforts to found a college for working men, receive special attention.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "John Henry Newman," *Great Lives from History: British and Commonwealth Series*. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 1953-1958.

One of England's premier prose stylists, and certainly her most famous religious convert of the nineteenth century, is presented in this brief biographical sketch. Newman's involvement with the Oxford Movement, his conversion to Roman Catholicism, and his efforts to heal the wounds caused by the great schism in the Anglican Church are detailed.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "Nikos Kazantzakis, *The Last Temptation of Christ*," *Masterplots II: Foreign Authors Series*. Englewood Cliffs, New Jersey: Salem Press, 1988, pp. 820-824.

This brief analysis provides an introduction to the novel, focusing on the way Kazantzakis uses the story of Christ as an emblem for modern man's existential struggle to find meaning in a meaningless world.

MAZZENO, Laurence W., Lieutenant Colonel, USA, and Allan B. Lefcowitz, Professor, "Matthew Arnold, James Bryce, and the Idea of Democracy," *Matthew Arnold in His Time and Ours*, ed. Forrest Burt and Clint Machann. Charlottesville: University Press of Virginia, 1988, pp. 71-80.

An essay in a major new collection published to commemorate the centennial of Matthew Arnold's death, this article examines Arnold's attitudes toward democracy by contrasting them with the opinions of a famous contemporary, British politician and historian James Bryce. While Bryce saw great promise for America and for democracy in general, Arnold remained more reserved, finding the possibility that the tyranny of the majority could have devastating effects on a nation's culture, and could lead it backwards rather than forwards in its quest to become more civilized.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "John Updike's *Roger's Version*," *Magill's Literary Annual*, 1987. Englewood Cliffs, New Jersey: Salem Press, 1987, II, pp. 727-731.

This review essay examines Updike's novel about a man who has religious doubts and marital problems, and of a young student bent on proving the existence of God by using the computer. Typical of Updike fiction, the novel contains much introspection by the main character; as always, Updike's style is virtually flawless.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "The Chairman--Two Views," *The Chronicle of Higher Education*, 34, 4 (23 September 1987), B3.

This poem provides a lighthearted, satiric look at the life of an administrator in higher education. The basic vehicle for comparison is the Arthurian legend, as the department chair is described as a modern-day King Arthur.

MAZZENO, Laurence W., Lieutenant Colonel, USA, and Allan B. Lescowitz, Professor, Editors, *The Arnoldian: Special Centenary Issue*, 15, 1 (Winter 1987-88).

To celebrate the centennial of the death of British poet and critic Matthew Arnold, *The Arnoldian* collected essays from distinguished critics and scholars worldwide. This collection contains six essays detailing Arnold's legacy in poetry, drama, criticism, social commentary, and education. It also contains retrospective reviews of some of the more important works of scholarship on Arnold published during the last century.

NOLAN, Charles J., Jr., Professor, Contributions to the *Annual Bibliography of English Language and Literature*. Volume 59. Eds. Michael Smith, Elizabeth Erskine, Mary Jear DeMarr, and D. Gene England. Leeds, Great Britain: Modern Humanities Research Association, 1987.

Contributions to the *Annual Bibliography* come from a careful review of the many issues of fourteen journals ranging from *Anthropological Linguistics* to the *International Philosophical Quarterly*. The contributor examines and notes any article, edition, book, or thesis, published in any language, that has an important link to English or American language or literature and any ancillary work that bears significantly on those fields. The *Annual Bibliography* is one of the two major bibliographies in English studies.

NOLAN, Charles J., Jr., Professor, "Hemingway's Women's Movement," reprinted in *Ernest Hemingway: Six Decades of Criticism*, ed. Linda W. Wagner. East Lansing: Michigan State University Press, 1987, pp. 209-219.

Hemingway's troubles with women are legendary. Beginning with his quarrel with his mother and running throughout his relationships with his four wives and with others, Hemingway's sometimes public disagreements helped to create his popular image as a woman-hater. As if biographical detail were not enough, stories like "The Short Happy Life of Francis Macomber," with its unforgettable depiction of five-letter Margot and, by extension, of all of American womanhood, worked to solidify the portrait. But for all the clamor, recently joined by feminist critics, there is another side to this major if troubled artist. Whatever his personal idiosyncrasies (and there were many), as a writer he saw more clearly than perhaps even he knew. Throughout his work up to the late thirties, there runs a strong sympathy for the plight of women, a sympathy that at one point, in fact, is expressed in contemporary rhetoric and rage.

NOLAN, Charles J., Jr., Professor, "Catherine Barkley: Hemingway's Scottish Heroine," *The Hemingway Review*, 7, 1 (1987), 43-44.

Every reader familiar with *A Farewell to Arms* knows that Frederic Henry falls in love with the beautiful, blond, English V.A.D., Catherine Barkley. Catherine is blond and lovely, it is true, and she is a V.A.D., a kind of nurse's aide, but what she clearly is not is "English." Apparently, most critics have overlooked what Catherine herself says when she and Frederic discuss the possibility of marrying. What is more interesting than this apparent oversight, however, is the possibility that Hemingway intended the friendship between Catherine and Helen Ferguson to predate the war. We know that Hemingway was using both Burke's and Debrett's listing of the peerage at the time he was writing *Farewell*, and Burke's *Peerage* makes clear the Ayrshire (Scotland) residency of the Barclay and Ferguson families. Hemingway's purpose in conceiving of Catherine and Fergy's relationship as such a well-established one is to make Catherine's actions more believable when Frederic joins the two nurses in Stresa after he has deserted.

PARKER, Michael P., Associate Professor, "Suckling in Paris," *Notes & Queries*, NS 34.3 (September 1987), 316-318.

The activities of Sir John Suckling after his precipitate flight from England in May 1641 have long been obscure. A hitherto unnoticed mention of Suckling in the Leicester correspondence, however, describes his reception in Paris and provides some insight into his mental state during this period. The poet apparently found exile uncongenial and fell prey to the depression that had afflicted him at other crucial points in his career. This last-known reference to Suckling alive is important inasmuch as it bolsters the tradition that he died a suicide sometime during the winter of 1641-1642; it also provides a valuable commentary on the situation of royalist refugees in France during the early 1640s.

TINSLEY, Molly B., Associate Professor, "Tender Nothings," *Oxford Magazine*, 3, 1 (Spring 1987), 29-36.

The narrator and protagonist of this story is a teenaged girl who runs away from her home in North Carolina after her younger brother dies of cancer. She takes a job in a Nautilus Club, where an encounter with a strange young man puts her in touch with the grief she has tried to deny.

TINSLEY, Molly B., Associate Professor, "Everyone Catch on Love," *West Branch*, 21/22 (1988), 160-177.

This coming of age story takes place in Stockholm, Sweden, where the young narrator is initiated into the world of romance and sexuality through a series of encounters--first with two older girls, then with an older boy, but in general, with the more open Swedish culture. Meanwhile, she tries to make sense of her experiences in terms of the French language she is memorizing in school.

TOMLINSON, David O., Professor, "John Pendleton Kennedy," *Fifty Southern Writers Before 1900: A Bio-Bibliographical Sourcebook*, Eds. Robert Bain and Joseph M. Flora, New York: Greenwood Press, 1987, pp. 286-295.

Kennedy, an important literary figure in the 1830s and 1840s, not only wrote the best of the plantation fiction coming out of that era, *Swallow Barn*; but he also delved into historical fiction with *Horse-Shoe Robinson* and *Rob of the Bowl*. More obscure than these was his political parody, *Annals of Quonibet*. This small body of work caused him to be hailed as the successor to Cooper and Irving in American fiction. His friendships with Edgar Allan Poe and with the great Irving himself were legendary. Kennedy's portrait and that of his wife hang today in Irving's dining room at Sunnyside. Kennedy

knew and socialized with most American writers of his era, but he also had the attention of a number of the British fiction writers--Dickens, Thackeray, and Bulwer-Lytton, for example.

The article not only traces Kennedy's literary associations, but his careers as lawyer, educator, and politician. Indeed, it reveals the sources for a detailed study of his life and his works.

WHITE, David A., Associate Professor, "Evelyn Waugh," *Magill's Literary Annual*, 1987. Englewood Cliffs, New Jersey: Salem Press, 1987, pp. 293-297.

This review essay on the first volume of Martin Stannard's new biography of British novelist Evelyn Waugh focuses on Waugh's early years, education, and his early successes as a novelist up to the eve of World War II. The essayist examines the author's presentation of the influences on Waugh, his artistic vision, and his conversion to Catholicism and its influence on his writing. The change in his literary style just before the War is given close attention.

WOOTEN, John, Associate Professor, "Dionysus Superstar," *National Review*, 14 August 1987, pp. 51-52.

This brief essay examines Robert Pattison's *The Triumph of Vulgarity: Rock Music in the Mirror of Romanticism*, and finds the book the most brilliant study yet written of the cultural and philosophical significance of rock music. Locating the roots of rock in Romantic pantheism and primitivism, Pattison conclusively demonstrates the inherent solipsism that marks rock and the rock culture. Although Pattison would downplay the dangerous influence of rock, his book makes for the most chilling assessment of the phenomenon yet presented.

WILCOXON, Hardy C., Assistant Professor, "Hardening of the Analogies: On Metaphors in Ordinary Life," *Perspectives in American Studies: A Reader by American Scholars in China*, Eds. W. Patrick Strauss, Kenneth Starek, and David Yaukey, Shanghai, China: Shanghai Foreign Language Education Press, 1988, pp. 245-267.

This essay is an examination into the nature and function of figurative language, specifically metaphoric expression, in daily, "ordinary" use. The author defines terms to establish a basis for his analysis, and then comments on the importance of metaphor to communication and understanding by citing examples from literature and his own experience. The essential thesis of this article addresses how imprecision in use of figuration may thwart communication and lead to misunderstanding. In so doing the author seeks also to convey the essential nature of the American character and society to his Chinese audience, and to extend their understanding of them. It is a well

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## Presentations

ARBUTHNOT, Nancy Prothro, Associate Professor, "Poetry Reading," Corcoran School of Art, Washington, DC, 4 February 1988.

ARBUTHNOT, Nancy Prothro, Associate Professor, "Poetry Reading," New River Reading Series, Bethesda, Maryland, 14 May 1988.

BERGMANN, Harriet F., Associate Professor, "The Handmaid's Tale in the Classroom," Pedagogy Workshop, George Mason University, Alexandria, Virginia, 14 October 1987.

BROWNE, Marlene C., Associate Professor, "When Tutoring Ends and Counseling Begins," The Writing Center, United States Naval Academy, Annapolis, Maryland, 18 March 1988.

BURKE, Carol, Assistant Professor, "Vision Stories," American Folklore Society's Annual Conference, Albuquerque, New Mexico, 22 October 1987.

BURKE, Carol, Assistant Professor, "Women's Narratives," American Anthropological Conference, Chicago, Illinois, 19 November 1987.

BURKE, Carol, Assistant Professor, "Staff Development," Southeastern Writing Centers Association, Charleston, South Carolina, 17 March 1988.

BURKE, Carol, Assistant Professor, "Gifted Women," Northeastern Anthropological Association Conference, Albany, New York, 20 March 1988.

CLARIDGE, Laura, Assistant Professor, "Shelley's Silent Women," Ohio State Conference on Narrative Poetics, Columbus, Ohio, 7 April 1988.

CLARIDGE, Laura, Assistant Professor, "The Killing Kindness of Desire: Wordsworth's Poems on the Naming of Places," Lacan, Language, and Literature Conference, Kent State University, Kent, Ohio, 29 May 1988.

DEKORNFIELD, Thomas, Lieutenant, USN, "Reading of short story, 'Bari,'" New River Reading Series, Bethesda, Maryland, 20 February 1988.

FLEMING, Bruce E., Assistant Professor, "Pictures of Pictures: Two Film Script Versions of Eisenstein's *Potemkin*," Thirteenth Annual Florida State University Conference on Film and Literature, "Intertextuality," Tallahassee, Florida, 28 January 1988.

FLEMING, Bruce E., Assistant Professor, "Teaching Written Works in an Oral Culture: The Example of Rwanda," "Perspectives on Speech and Writing," Annual Meeting of the College English Association, Middle Atlantic Group, Catholic University, Washington, DC, 26 March 1988.

HOWLAND, Mary D., Assistant Professor, "Writing in Response to Literature," Southeastern Writing Centers Association Conference, Charleston, South Carolina, 4 March 1988.

JASON, Philip K., Professor, "Poetry Reading," New Rivers Reading Series, Bethesda, Maryland, 19 March 1988.

JASON, Philip K., Professor, "Vision and Tradition in Vietnam War Fiction," Popular Culture Association Annual Meeting, New Orleans, Louisiana, 24 March 1988.

LEFCOWITZ, Allan B., Professor, "Current Trends Affecting Writers," The American Institute of Retirement Learning, Washington, DC, 21 July 1987.

LEFCOWITZ, Allan B., Professor, "A Washington Poetry?," Federal Poets in Celebration of National Poetry Day, Washington, DC, 18 October 1987.

LEFCOWITZ, Allan B., "How to Handle Manuscript Rejection," The Washington Independent Writers' Seminar on Rejection, Washington, DC, 18 April 1988.

MADISON, Robert D., Assistant Professor, "Melville's Cheever and Scoresby's Cheever," American Culture Association, New Orleans, Louisiana, 24 March 1988.

MAZZENO, Laurence W., Lieutenant Colonel, USA, "Short Story Reading," New River Reading Series, Bethesda, Maryland, 19 March 1988.

NOLAN, Charles J., Jr., Professor, "Mark Twain Among the Teddy Bears and Presbyterians: Annapolis 1907," St. John's College, Annapolis, Maryland, 12 January 1988.

NOLAN, Charles J., Jr., Professor, "Heller's Small Debt to Hemingway," Conference of the College English Association, New Orleans, Louisiana, 16 April 1988.

## ENGLISH

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O'BRIEN, Timothy D., Associate Professor, "Science and Satire in Chaucer's 'The Summoner's Tale,'" Sixth Annual Citadel Conference on Literature, Charleston, South Carolina, 11 March 1988.

PARKER, Michael P., Associate Professor, "The Annapolis Career of William Oliver Stevens," a special exhibit at the Nimitz Library, United States Naval Academy, Annapolis, Maryland, 14 December 1987 - 24 February 1988.

RENWICK, Joyce, Instructor, "Approaching Fiction," Yorktown High School, Arlington, Virginia, 20 November 1987.

RENWICK, Joyce, Instructor, "Sportin' Life," New River Reading Series, Bethesda, Maryland, 23 January 1988.

RENWICK, Joyce, Instructor, "Getting Started in Fiction," Chantilly Writers' Conference, Chantilly, Virginia, 13 April 1988.

RENWICK, Joyce, Instructor, "Indian Morning," Third Annual Apprentice Writers' Workshop, Rockville, Maryland, 29 April 1988.

RENWICK, Joyce, Instructor, "Beginnings: Arousing Expectations in Fiction," Third Annual Apprentice Writers' Workshop, Rockville, Maryland, 30 April 1988.

ROSS, Stephen M., Professor, "Narrative in Faulkner," Northeast Modern Language Association, Providence, Rhode Island, 25 March 1988.

TINSLEY, Molly B., Associate Professor, "Fiction Reading," New River Reading Series, Bethesda, Maryland, 23 January 1988.

TOMLINSON, David O., Professor, "John Pendleton Kennedy and the Cavaliers," Conference on Maryland, Frostburg State University, Frostburg, Maryland, 14 October 1987.

TOMLINSON, David O., Professor, "Mark Twain in Annapolis," St. John's Evening Historical Lecture Series, St. John's College, Annapolis, Maryland, 12 January 1988.

TOMLINSON, David O., Professor, "John Pendleton Kennedy in New York State," Conference on New York State, Siena College, Loudonville, New York, 15 April 1988.

WILCOXON, Hardy C., Assistant Professor, "Teaching and Learning in the People's Republic of China," College English Association, New Orleans, Louisiana, 17 April 1988.

WOOTEN, John, Associate Professor, "Panel Discussion on NEH Summer Institutes," Modern Language Association Annual Meeting, San Francisco, California, 28 December 1987.

WOOTEN, John, Associate Professor, "Chair of First Session," Third International Milton Symposium, Florence, Italy, 12 June 1988.



# History

Professor Frederick S. Harrod  
Chairman

During the past year, members of the History Department undertook extensive research and presented their results in a variety of forums. The discipline of history encourages diversity, and the work of the faculty encompasses many subjects and methodologies. Projects and presentations range from the semantic study of literary evidence from the Roman Empire to an analysis of the on-going Gulf war. A statistical summary provides a quick view of the Department's endeavors: in the past year members have published six books, edited three others, served as series editor for four books, published five articles, and presented nineteen papers. Numbers alone, of course, say nothing about the quality of work. In this regard, the Department is pleased at the high standards of research and writing reflected in these activities. Among the publications, for example, are books issued by prestigious university presses: *Lordship and Military Obligation in Anglo-Saxon England* (University of California Press), by Associate Professor Richard Abels; *Public Drinking and Popular Culture in Eighteenth-Century Paris* (Princeton University Press), by Associate Professor Thomas Brennan; and *John L. Sullivan and His America* (University of Illinois Press), by Assistant Professor Michael Isenberg.

This year's publications also illustrate the Department's continuing leadership in naval historical scholarship. Lieutenant Commander Thomas Cutler's *Brown Water, Black Berets: Coastal and Riverine Warfare in Vietnam* has been an exceptionally well-received publication by the Naval Institute Press. Additionally, this year saw the publication of *Naval History: The Seventh Naval History Symposium of the U.S. Naval Academy*, edited by Assistant Professor William Cogar. This symposium has become a major forum for scholarship dealing with naval history, and the publication



of selected papers has ensured high-quality to the biannual symposium.

Scholarly activity has contributed to the life of the Department in other ways not so apparent in the following listings. Faculty members have participated in an extended series of Works-in-Progress seminars in which individuals submit drafts of papers, articles, and chapters for the review and comment of their colleagues. They have also been particularly successful in conveying their own excitement about learning in the classroom.

## Sponsored Research

### A Computer Analysis of the Skipper Problem of World War II

Researcher: Professor William L. Calderhead

Sponsor: Naval Academy Instructional Development Advisory Committee

During World War II the submarine command in the Pacific faced a problem of selecting the best skippers (lieutenant commanders) to command submarines on war patrols. Some of these young officers enjoyed outstanding results, while others did very poorly. This problem poses--45 years after the event--an interesting question in combat leadership: would it be possible to predict in advance by some statistical method (made easier by using computer techniques) the chances of possible

success among a pool of 400 or more submarine commanders? This computer research uses nine or ten quantifiable variables related to the degree of combat success among those 400 commanders. In the fall semester, this system was established as a pilot project for one section of students in HH 204, American Naval Heritage. After that successful first trial, the project was expanded to two more sections, again with good results.

### Robert F. Stockton and John Ericsson: Political Conflict over Technological Change

Researcher: Assistant Professor William B. Cogar

Sponsor: Naval Academy Research Council (OMN)

Few men exhibited greater versatility, interest, and influence on the United States Navy than Robert F. Stockton. He was significant in transforming the Navy from the Age of Sail to the Age of Steam, yet seldom has his role been understood or appreciated. It was Stockton who first met and convinced John Ericsson, then promoting a revolutionary iron screw steamer in Britain, to come to the United States,

thereby campaigning to build steam vessels and improve the size and strength of the U.S. Navy. The two men worked tirelessly in designing and building the Navy's first steam-powered screw warship, the *USS Princeton*. Sadly, though, this relationship deteriorated, tragic fatalities beset the *Princeton* while it was under Stockton's command, and his career was eventually tarnished.

## HISTORY

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### **Patriotism for Profit: Georgia's Urban Entrepreneurs and the Confederate War Effort**

Researcher: Assistant Professor Mary A. DeCredico  
Sponsor: Naval Academy Research Council (OMN)

This research examines the response of private businessmen in the quartermaster, ordinance, and transportation sectors of the Confederate States of America in Georgia. Particular attention is devoted to the activities of men in Atlanta, Savannah, Augusta, and Columbus. These businessmen built upon and expanded the industrial foundation laid before secession and created a substantial military-

industrial complex. Their activities and successes profited them personally and aided the Confederate war effort. Success in wartime pursuits was not dampened by Civil War defeat. Rather, these businessmen re-emerged after the war to lead the rebuilding of Georgia, and they were emulated by a new cohort of entrepreneurs who pushed Georgia successfully into the New South era.

### **Dual Object Theories of Identity, Existence, and Modality**

Researcher: Lieutenant Jan C. Dejnozka, USNR  
Sponsor: Naval Academy Research Council (OMN)

Philosophical discussions of objects, identity, existence, and modality may be found in abundance in antiquity and throughout the Western philosophical tradition. The earliest philosophers were concerned with the question of what remains the same through natural and social change. Aristotle's substance, Hegel's determinate being, and Bradley's notion of a thing all involve some connection among the concepts of object, identity, existence, and essence. This sort of connection has been developed in the analytic tradition by Frege, Russell,

Wittgenstein, Quine, and Strawson. In particular, this project has been concerned with Castaneda and Butchvarov, whose theories are sufficiently developed to offer explicity unified accounts of identity, existences, modality, and propositional modality. The objective is to develop a new unified dual object theory of identity, existence, and modality which is more adequate than earlier theories in terms of accounting for data and explaining difficulties.

### **Computer-Aided Instruction in Logic**

Researcher: Professor David E. Johnson  
Sponsor: Naval Academy Instructional Development Advisory Committee

The goal of this project is to find or develop courseware for use by midshipmen in learning logic. The software could be applied to any of the four philosophy courses in the curriculum. Because of the lack of background for most midshipmen in logic and philosophy, more material could be

covered in the courses if the students could learn some rudiments of logic on their own time using personal computers. This project has entailed the evaluation of two dozen programs currently under development; one has been selected for classroom testing.

## HISTORY

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### **The Peruvian APRISTA Party and its Relationship with the United States during World War II**

Researcher: Associate Professor Daniel M. Masterson  
Sponsor: Naval Academy Research Council (OMN)

This project analyzes the public and clandestine international policy of Peru's American Popular Revolutionary Alliance (APRA) during the World War II years. Earlier work focused upon the APRA leadership's effort to attain political legality and international prestige by moderating its anti-American international program and offering covert and public assistance to Washington's anti-Axis policies in Peru. The new study expands on this theme to analyze APRA's efforts in Peru and all of

Latin America to enlist the support of government leaders and prominent political figures for its programs. An important element of this effort was an international campaign in Mexico, Bolivia, and Chile. The focus is upon anti-Axis activities of APRA as it sought to portray itself as being in the vanguard of democracy in Latin America, and as Washington's most important political ally in the region.

### **Twentieth Century American Photography**

Researcher: Assistant Professor David P. Peeler  
Sponsors: National Endowment for the Humanities and Naval Academy Research Council (OMN)

This project is an examination of the growth of American photography in the twentieth century. The researcher looks at the ideas and values of leading American photographers, and the ways in which they brought those beliefs and values to fruition in their work. The research fills a gap in the existing scholarship, for while there is a substantial body of art criticism on the medium, there is no substantial treatment of the ideas associated with creative

photography. The project's central question is: In what ways did these creative individuals seek to resolve the tension that arose from working in a medium with an almost worshipful attitude toward objectivity, while daily seeing the evidence in their own work that even the simplest fact cannot be presented without altering its "pure" objectivity in some way?

### **Samuel Baldwin Marks Young: The First Army Chief of Staff**

Researcher: Assistant Professor William R. Roberts  
Sponsor: Naval Academy Research Council (OMN)

This research is an examination of the life and career of Samuel Baldwin Marks Young (1840-1924), who served as the first chief of staff of the United States Army. Young's Army career spanned forty-three years (1861-1904), three wars (the Civil War, the Spanish-American War, and the Philippine Insurrection), and frequent scrapes with Indians and rustlers, as well as action in the American West. The study of his life and times will help to illuminate the nature of military service and civil-military

relations in the late nineteenth and early twentieth centuries. As president of the Army's War College Board (a forerunner of the General Staff), he not only helped transform the Army's command structure but also introduced a number of important educational reforms. Ironically, Young had neither attended the Military Academy nor gone to college, yet the reforms he helped bring about made it less likely that officers like him would hold important positions in the future.

## HISTORY

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### **From Knowledge, Sea Power: A History of Research at the U.S. Naval Academy**

Researcher: Associate Professor Jack Sweetman  
Sponsor: Naval Academy Research Council (OMN)

This project examines the relationship between classroom teaching and intellectual creativity in the research activities of the United States Naval Academy. It was, for example, as a lecture demonstration that in 1877 Ensign Albert A. Michelson began conducting the experiments to measure the speed of light, experiments that led him to become the first American to receive the Nobel Prize for Physics. Similarly, it was research done in support of the Academy's naval history course that, early in

this century, brought the Academy a reputation it still enjoys as a center for the study of naval history. Since the 1960's, the development of a sponsored research program administered by the Naval Academy Research Council, the creation of research professorships, and the initiation of the Trident Scholars Program have greatly enhanced the research opportunities of faculty and midshipmen alike.

### **Business and Politics in the Gilded Age**

Researcher: Professor Craig L. Symonds  
Sponsor: Naval Academy Research Council (OMN)

This project began as a study of the character of American society during the Civil War-Gilded Age era (1860-1900). It was originally to be an exploration of the relationship between the entrepreneurs of the Gilded Age of American history and politicians of that era. Investigation into the lives of various entrepreneurs and politicians in the years following the Civil War initially focused upon the lives and post-war careers of several Confederate general officers--many of whom engaged in subsequent careers in either business or government, and frequently both. One such officer was Joseph E.

Johnston who, after surrendering the last Confederate army in the East to William Tecumseh Sherman in April 1865, spent the next decade as an apologist for the Old South, as a railroad company executive, and finally as a congressman from North Carolina. Johnston represents many of the important forces at work within late nineteenth-century America, and yet surprisingly he has been the subject of only limited modern scholarship. The focus of the research project accordingly shifted, and it has now grown into a full-length biographical study of Joseph E. Johnston.

### **Computer Assisted Systems for Classroom Visual Aids**

Researchers: Professors Philip W. Warkin and Larry V. Thompson  
Sponsor: Naval Academy Instructional Development Advisory Committee

The investigators completed an inventory of the departmental slide collection and began initial preparations for production of a video disc of those images. Concurrently, they secured and evaluated interactive history software. In the course of their evaluation, they discovered Virtual Video Producer, an integrated hardware and software system that permits the capture of visual images from any video

source, creates custom graphics, overwrites text and titles, and transfers all information to computers. The system was secured, and demonstrated at the Academy's software fair in early September. The Virtual Video Producer is easy to use and will eventually allow faculty members to create personalized classroom presentations.

# Independent Research

## **The Transformation of English Culture, 1910-1922: Tradition, Modernity, and the Great War**

Researcher: Associate Professor Theodore W. Bogacz

This is a synthetic study with broad implications for the cultural and social history of modern England. It examines important aspects of English culture as they underwent radical change during the impress of total war. Among other areas studied are: the transformation of language during World War I; the reception of new views of psychology and mental illness under the impact of the "shell-shock" crisis on the Western front; the triumph of modernist vision in the fine arts as other styles failed to capture the

nature of contemporary war; and ultimately the growing acceptance of the conditions of "modernity" in English culture as a whole. The years 1910-1922 in England were a period of profound cultural crisis, and World War I was a radically modernizing force in all areas of English life. A major part of this book will be to chart the resistance to and final acceptance of the forces of modernity in English culture during these dramatic years.

## **Towards the Cultural History of Alcohol in France**

Researcher: Associate Professor Thomas Brennan

This is a survey of the literature relating to the history of alcohol in France. It argues that the growing interest in the social history of alcohol is still flawed in its reliance on quantifying consumption and anthropological terms. Using nineteenth-century statistics for consumption, the paper demonstrates that the government and elites

overreacted considerably to the perceived changes in alcohol consumption, indeed that the creation of temperance movements and legal restraints on drinking were in response to class and cultural antagonisms rather than to a real change in consumption patterns.

## **The State's Navy: An Examination of the English Navy During the Interregnum**

Researcher: Assistant Professor William B. Cogar

This project examines both the administrative innovations as well as the political sentiments within the English Navy, both at sea as well as in the shore administration, during one of the most turbulent periods in English history. The general thesis is

that the innovation by so-called 'radicals' in fact established an administrative system which became the basis for the Navy run by Samuel Pepys and which began its ascent to British maritime supremacy and naval hegemony.

## **The Eighth Naval History Symposium: Select Papers**

Researcher: Assistant Professor William B. Cogar

This publication will contain twenty selected papers from the Eighth Naval History Symposium, held at the Naval Academy under the History Department's sponsorship. Each of the contributions represents

a significant chapter in the realm of naval and maritime history, and was selected from among fifty-two papers delivered at the symposium.

## HISTORY

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### **Flag Officers of the Sea Service: Vol. II, 1901-1918**

Researcher: Assistant Professor William B. Cogar

This is the second of a multi-volume series which examines every flag rank officer in the U.S. Navy, the U.S. Marine Corps, and the U.S. Coast Guard from 1862 (when the sea service first used the rank of Admiral) to the present. Each entry contains

personal information, a photograph, a career summary, a paragraph of "career highlights," and bibliographical information. As part of the larger series, it will fill a longstanding gap in scholarly reference materials.

### **The Gulf of Tonkin Revisited**

Researcher: Lieutenant Commander Thomas J. Cutler, USN

The Tonkin Gulf incident has long been a controversial subject. But historians have been, and continue to be, seduced into pursuing the interesting--but not terribly significant--question of whether or not the second of two reported attacks actually occurred. What should be of greater inter-

est is the aftermath of the incidents, when members of the Administration omitted relevant facts and overtly deceived Congress. This project explores those aspects of the incident, and attempts to delineate what is truly important about the Tonkin Gulf events.

### **On the Border of Eden: The Story of the Souls**

Researcher: Associate Professor Nancy W. Ellenberger

This is a study in the social history of the British upper class at the end of Victoria's reign. It examines a group (the "Souls") of some three dozen aristocrats who figured prominently in the social and political life of the nation before the First World War. The work is based on a number of collections

of family papers that are still in private hands and that have not been used before by historians. Based upon these personal effects, this project analyzes the ideas, attitudes, and behavior of the group within the context of the social, political, and economic changes affecting their class as a whole.

### **The United States Navy in the 1850's**

Researcher: Professor Kenneth J. Hagan

This project is a history of the United States Navy in the 1850's, pointing out that this was a decade of intense activity all around the world. The Navy actively supported commercial expansion and seamen's rights at a time when the American commercial and whaling fleets were relatively at their larg-

est. This activity included hints of territorial expansion cut short by the Civil War. It also was greatly influenced by the advent of steam, which made the absence of overseas coaling stations a difficult operational problem.

### **Shield of the Republic**

Researcher: Assistant Professor Michael T. Isenberg

This book-length project covers the institutional history of the United States Navy from 1945 to 1989. It traces the growth and development of the contemporary Navy both as an agency of the United

States government, and as an institution within the broader American context. It focuses upon changing personnel, policy, hardware, and technology.

## HISTORY

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### **The Flame of Burgessing: Elections and the Political Communities of Colonial Virginia, 1728-1775**

Researcher: Assistant Professor John G. Kolp

Elections to the eighteenth-century Virginia House of Burgesses have been of long-standing interest to historians because of the role they played in the early political careers of a number of America's Founding Fathers. Although these men were selected for office within their local county constituencies by a substantial proportion of the adult male population, it has never been completely clear what meaning should be attached to those political events. Examination of surviving data on all elections for the period reveals a pattern of gradual

decrease in electoral competitiveness over the years, but also demonstrates substantial regional variation that does not fit traditional interpretations. A number of themes emerge from detailed case studies of three counties, including the importance of tenants in the election process, the broad spectrum of issues colonial voters thought germane, the remarkable stability of voting behavior, the importance of previous office-holding to candidate success, and the role of local neighborhoods in defining electoral choice.

### **The History of the United States Navy**

Researcher: Associate Professor Robert W. Love, Jr.

This survey of American naval history covers the U.S. Navy from the Revolutionary War up to the reflagging of Kuwaiti tankers in the 1988 Gulf War.

The emphasis is on the fleet as an arm of American foreign policy, and on the evolution of the Navy as an instrument of that policy overseas.

### **Colonialism and Work in the Congo Basin: A History of Social Change in the Tshuapa Region (Zaire), 1880 to 1940**

Researcher: Assistant Professor Samuel H. Nelson

This research project is a detailed and multi-dimensional examination of African social change at the local level during the first six decades of Belgian colonialism in Zaire. Specifically, the researcher endeavors to trace a variety of social and cultural responses made by villagers of the Mongo ethnic group, as they adapted to meet changing economic, political, and social conditions triggered by international commerce and colonial rule. In keeping with this major theme, the study incorporates an often neglected historical perspective: the past as it was experienced, perceived, and shaped by local African societies. To achieve this "grass-roots" perspective and to overcome the lack of conven-

tionally used historical sources, the project employs an innovative methodological framework based on a history of changing local work patterns and relations in the Tshuapa region of the Congo basin. By exploring the individual and daily experiences of the Mongo as they secured the provisions necessary for survival, changed residences, moved into different work patterns, and experienced cycles of prosperity and poverty, the study provides a more detailed and dynamic view of African social change than that common to most colonial studies. Moreover, the project seeks to make a significant contribution to the understanding of an area long overlooked by most historians.

## HISTORY

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### **Social History of the Deaf Community in France During the Nineteenth Century**

Researcher: Associate Professor Anne T. Quartararo

This research project is an examination of the social, cultural, and sometimes political forces that shaped the deaf community in France during the nineteenth century. This study of the deaf community will reveal not only the collective mentality of the nation's leadership group (the political and professional elites) toward the deaf, but more important, will analyze the values of the deaf community as it interacted with the dominant hearing population. The researcher will first examine the period 1789-1815 and discuss how charity and per-

ceptions of social deviance affected the deaf population. The second part of the project will cover the relationship between bourgeois and deaf culture in the period 1815-1880. How the deaf structured their lives and how the hearing world reacted to deaf culture will be studied through medicine, education, and welfare policy. The last segment of the project deals with the period 1880-1914 and how the issue of social integration directly affected the deaf community.

### **Schooling Girls in Napoleon III's France: Marie Caillard's Reports from the Southwest**

Researcher: Associate Professor Anne T. Quartararo

This project investigates the material and social conditions of girls' public primary schooling in mid-nineteenth century France as reported by a woman inspector of schools, Marie Caillard. The researcher has used three departments in southwestern France to understand the strengths and weaknesses of girls' popular education. Marie

Caillard's reports are a unique source for the historian in the attempt to reconstruct the problems inherent to the spread of popular education. Caillard's commentary provides insight into the local limitations of primary schooling and the pressure from Paris to invest more money in the education of lower class girls.

### **The Origins of the Modern American General Staff**

Researcher: Assistant Professor William R. Roberts

Previous historians have argued that the American General Staff was patterned after the Prussian General Staff in order to make the American Army a more effective fighting force. This research leads to the conclusion that the staff reforms introduced at the beginning of the twentieth century represented the culmination of a long-standing struggle for power between line and staff officers, as well as

another struggle for power between the secretary of war and the nineteenth-century commanding general. Supporters of the creation of the General Staff in 1903 wanted to strengthen the secretary and the line as much as they wanted to improve the fighting skills of the army. Their reforms provided a foundation for the growing bureaucratization of the military establishment in this century.

### **Geographic Illiteracy at the United States Naval Academy**

Researcher: Lieutenant Maxwell Shaw, USN

Preliminary surveys indicate a lack of adequate geographic knowledge among entering students at the Naval Academy. This project will expand upon

those early surveys, and examine the role of core courses in meeting the needs for a geographically-informed student body.

## HISTORY

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### Ramus and Reform

Researcher: Assistant Professor James V. Skalnik

The project is a book-length study of the transformation of French society in the sixteenth century, seen through the life and works of the humanist educator Petrus Ramus (Pierre de la Maree, 1515-1572). The study demonstrates that the meritocratic society of Renaissance France gave way to an oligarchic and hierarchical social order after about 1550, largely due to demographic growth and economic slowdown. The vexing problem of why "Ramus" was so popular in Europe is resolved by showing that Ramus developed an ideology of meri-

tocracy which united many followers in opposition to the prevailing trend toward oligarchy. His efforts to put this theory into practice, although ultimately unsuccessful, constitute crucial chapters in the history of the French Reformed Church and of French education. The study draws extensively on unpublished material in Parisian archives and relies on the techniques of collective biography, computer-assisted analysis of sixteenth-century publication data, and the sociology of ideologies and mentalities.

### The Last Cavaliers: Horse Cavalry in the Twentieth Century

Researcher: Associate Professor Jack Sweetman

Conventional wisdom holds that World War I revealed cavalry to be an anachronism, but the issue is more complicated than that. Although the arm proved useless in the conditions of trench warfare that prevailed on the Western Front, it was extensively employed in the East, and some of the largest cavalry operations in history--those of the British Desert Mounted Corps--took place on the Palestine Front during 1917-1918. As late as the outbreak of World War II the army of every major power except

Great Britain included horse cavalry, and the German army actually had more mounted units at the end of the war than at the beginning. This project will combine operational and institutional history within a chronological framework to examine the technological and tactical developments that led to the gradual extinction of cavalry and the doctrines and means by which it attempted, unsuccessfully, to respond to the challenge those developments posed.

### The U.S. Marine Corps: An Illustrated History

Researcher: Associate Professor Jack Sweetman

This work is designed to provide a concise but authoritative history of the U.S. Marine Corps from the foundation of the Continental Marines in 1775 to the present. The narrative is to follow a chon-

ological format. The researcher will contribute chapters covering the period up to American intervention in World War I.

## HISTORY

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### **The Third Reich: A History**

Researcher: Professor Larry V. Thompson

This is projected to be a synthetic work. It will combine scholarship of the last decade with archival research to fashion an historiographical and analytical study that makes a contribution to recent German history. The two-volume work is aimed at specialists and advanced students. It examines

Germany's Nazi experience both chronologically and topically, stressing the history of everyday life under Nazism in an effort to place domestic politics in context with German diplomatic and military history that, while perhaps better known, is still quite controversial as to motives and objectives.

### **Mark Hanna's Election to the United States Senate**

Researcher: Professor Philip W. Warken

This project examines the campaign issues and tactics in the Ohio state legislative elections of 1897, and the maneuvering within and outside the legis-

lature that resulted in the election of Mark Hanna to the United States Senate in 1898.



# Research Course Projects

## The Argentine Navy in the Falklands War of 1982

Researcher: Midshipman 1/C Nelson J. Delgado, USN  
Adviser: Associate Professor Robert W. Love, Jr.

This research concentrated on Argentine sources that have not been published in the United States or translated into English. The researcher was able to utilize these archival materials, along with personal interviews, during a foreign exchange cruise in the Republic of Argentina. The central discovery was that the Argentine capture of South Georgia Island

was not part of the government's original war plan. Instead, the assault on South Georgia was a separate, erroneous operation, one that compromised Argentine operations by prematurely alerting the British opponents about the larger Falklands offensive.

## The Decision for Oil or Rail: Strategic Bombing Problems of 1944 in Europe

Researcher: Midshipman 1/C John O'Brien, USN  
Adviser: Professor Jack W. Huston

This project assesses the difficulties involved in decision making in World War II Europe concerning the use of strategic bombers in preparation for the invasion in the spring of 1944. The main arguments focus on whether the thrust of the American strategic bombers should be against German sites producing oil, aircraft, and other

industrial targets, or whether the bombers should be used to destroy (or at least immobilize) railway hubs, transportation networks, and communications potentially useful in defending against the anticipated American invasion. The researcher used primary source material from both the United States and Britain.

## The English Parliament of the Seventeenth Century

Researcher: Midshipman 2/C Gregory R. Shimp, USN  
Adviser: Associate Professor Thomas J. Brennan

The focus of this project was upon the Long Parliament. This Parliament met in 1640, was expelled by Oliver Cromwell in 1653, reconvened briefly in 1659, and was finally dissolved in 1660. As a central stage for national politics during much of the English Civil War, the Parliament serves as an

important barometer for measuring the storms that beset England during a period of intense civil unrest. Focusing upon the influence of rural districts, the researcher utilized the holdings of Nimitz Library along with other regional libraries.

## HISTORY

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### **Analysis of A Heresy: Segarello, Dolcino, and the Order of the Apostles**

Researcher: Midshipman 1/C Robert Thornhill, Jr., USN  
Adviser: Associate Professor Richard P. Abels

In the late Middle Ages heresy swept across Europe, challenging the authority of the Catholic Church. The central focus of many of these movements was the ideal of apostolic poverty. One of the most extreme of these sects, the sect of the Apostles of Christ, or, as they were called by their enemies, the pseudo-Apostles, was led by Fra Dolcino in northern Italy. This project examines the reasons why individuals were attracted to the "Order of the Apostles." As a heresy, the "Apostles" are only a footnote to most historians. The movement never spread outside the confines of Italy, and in fact, always remained centered in the same small part of northern Italy. The true historical value of

the Order lies not in these facts, but in what they demonstrate about their age. By studying them, one learns that apostolic poverty was an issue not only among Church figures. It had real impact down to the very roots of society. The movement attracted members of the lower classes who wanted to be part of the religious fervor of the times as much as the clerics or nobles. They were dissatisfied not only with the Church, but with the orders that were supposed to extol the lifestyle of the poor. In short, Segarello, Dolcino, and those who followed them brought to light issues that otherwise may become lost in the currents of the era.

### **Resistance Organizations in Maryland during the Civil Rights Era**

Researcher: Midshipman 2/C Jay F. Wigley, USN  
Adviser: Assistant Professor Mary A. DeCredico

This project examines the Civil Rights movement in the South with particular attention to the role of white resistance organizations. It concentrates on

Maryland and the White Citizens Council organizations of the 1950's and 1960's, all within the context of a broader Southern context.

## Publications

ABELS, Richard, Associate Professor, *Lordship and Military Obligation in Anglo-Saxon England*. Berkeley and Los Angeles: University of California Press/London:British Museum Publications, 1988.

Emphasizing the central importance of lordship, this book examines the evolution of military obligation from the Germanic invasions to the Battle of Hastings. It draws upon the most recent research in the fields of history, archaeology, anthropology, and Domesday Book studies to present a highly original portrait of the response of the rulers of Anglo-Saxon England to the challenge of chronic civil wars and repeated invasions. It stands in sharp contrast to the traditional portrayal of early Anglo-Saxon England as a society in which all free men were under an ancient obligation to defend their homeland. Instead, the gift of land and the reciprocal gifts of service lay at the heart of the military organization of Anglo-Saxon England, and kings, including Harold, were the lords of warrior bands who served both in satisfaction of the personal oaths they had sworn and in fulfillment of an obligation in the land they held.

ARTIGIANI, P. Robert, Associate Professor, "Cultural Evolution," *World Futures*, 23 (1987), 93-122.

The article discusses the evolution of human systems in neo-Darwinian terms. The emphasis is on a combination of mutation and selection processes. To establish the information which mutates, a semiotic model of communication in human systems is developed, while the basic elements of dissipative structures theory supply environmental fluctuations. The resulting synthesis is applied to the classic periodizations of Western history, and the model's utility in tracking symmetry-breaks and stabilizations is tested.

BOGACZ, Theodore W., Associate Professor, *Battleshock: Selected Readings*, A Department of War Studies Campaign Study. Sandhurst, England: Royal Military Academy, 1988.

This anthology, intended for British Army officers enrolled in Junior Command and Staff courses, contains eighteen selections dealing with the problems of battlefield stress and war neuroses. The introduction surveys the history of the "battle-

shock" phenomenon and outlines the lessons which must continually be re-learned regarding the management and treatment of battlefield stress. After treating the shell-shock episodes of World War I, the bulk of the selections emphasizes battlefield stress in post-1945 conflicts.

BRENNAN, Thomas, Associate Professor, *Public Drinking and Popular Culture in Eighteenth-Century Paris*. Princeton: Princeton University Press, 1988.

Adding a new dimension to the history of mentalities and the study of popular culture, this book has reinterpreted the culture of the laboring classes in old-regime Paris through the rituals of public drinking in neighborhood taverns. Brennan challenges the conventional depiction of lower-class debauchery and offers a reassessment of popular sociability. Using records of the Parisian police, he lets the common people describe their own behavior and beliefs. Their testimony places the tavern at the center of working men's social existence.

Central to this study is the clash of elite and popular culture as it was articulated in the different attitudes toward taverns. The elites saw in taverns the indiscipline and exuberance that they condemned in popular culture. Popular testimony presented public drinking in very different terms. The elaborate rituals surrounding public drinking and its prevalence in popular sociability point to the importance of drink as a medium of social exchange rather than as a drugged escape from misery, and to the tavern as a focal point for men's communities. This book has elucidated the logic of both elite and popular systems of meaning and returned the dignity of coherence to the culture and values of the populace.

COGAR, William B., Assistant Professor, *Naval History: The Seventh Naval History Symposium of the U.S. Naval Academy*. Wilmington, Delaware: Scholarly Resources, 1988.

This volume contains the selected papers from the Seventh Naval History Symposium, held at the U. S. Naval Academy in September 1985. Some twenty-six articles are included, ranging from reconstructing the classical Greek Trireme to the present controversy over the modern battleships.

## HISTORY

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CULHAM, Phyllis, Associate Professor, "Roman Roads, Greek Terms: Translation, Transliteration, and Transfer," *Glotta: Zeitschrift für Griechische und Lateinische Sprache*, 65 (1987), 161-170.

This article examines epigraphical evidence from the Roman Empire, material that constitutes an autonomous semantic field. Greek imperial epigraphic texts borrow from Latin in a way that Greek literary texts never do. The Greek semantic treatment of Roman administrative practice may in turn influence Latin epigraphic texts.

CULHAM, Phyllis, Associate Professor, "MUMS the Word," *Classical Bulletin*, 63 (1987), 77-81.

New databases enable the classical scholar to stay current with scholarship in the field, even if she or he is not at a major research university. Assets and liabilities of these systems are explored and advice for using them offered.

CULHAM, Phyllis, Associate Professor, "Social Science Approaches to Women in Antiquity: A Bibliography of Bibliographies, Part II," *Women's Classical Caucus Newsletter*, 12 (Fall 1987), 29-30.

This is an annotated bibliography of new bibliographic tools in the study of family and feminist theory.

CULHAM, Phyllis, Associate Professor, "Vergil of Mantua Watches the Manuscript of the Aeneid Burn in the Fireplace and Drinks His Wine Slowly While Thinking About the Pax Augusta," *Vengilius*, 33 (1987), 21-22.

This poem speaks from what Hartsock would call Vergil's "standpoint." It speculates darkly on the wholly spurious story that Vergil directed his executors to burn the manuscript of the Aeneid. Its variations on Vergiliana from Book VI and from the Georgics try desperately to avoid pastiche and achieve pathos.

CUTLER, Thomas J., Lieutenant Commander, USN, *Brown Water, Black Berets: Coastal and Riverine Warfare in Vietnam*. Annapolis: Naval Institute Press, 1988.

This book examines an overlooked part of American involvement in the Vietnam War—the U.S. Navy's brown-water force. Often using converted pleasure boats and aging landing craft to patrol the narrow rivers and shallow coastal waters of South Vietnam, the men of this unorthodox navy played a vital role in the war effort. The book draws upon the author's personal experiences, eyewitness descriptions from others who served, and official records. Both battles and daily camp life are examined, as the book details the development and operation of the Navy's brown-water fleet right up to the Vietnamization programs that marked U.S. troop withdrawal from Southeast Asia.

GOOD, Jane W., Associate Professor, and Karl M. KLEIN, Captain, USN, "Women in the Brigade," *Proceedings of the U.S. Naval Institute*, 114/A/1022 (April 1988), 103-108.

This article summarizes the findings of the Women Midshipmen Study Group in five areas: admissions, academic performance, physical performance, military performance, and brigade life. It includes the principal recommendations of the Study Group, recommendations presented to the Superintendent in hopes of improving the integration of women into the Brigade.

HAGAN, Kenneth J., Professor, co-author, *American Foreign Policy: A History*. Lexington, Massachusetts: D.C. Heath, 1988.

This is a textbook history of American foreign relations, tracing America's place within the world from the time of the American Revolution down to the present.

## HISTORY

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ISENBERG, Michael T., Assistant Professor, *John L. Sullivan and His America*. Urbana: University of Illinois Press, 1988.

This is a biography of American boxer John L. Sullivan (1858-1918), tracing his life and career, and placing both within the larger context of American culture and sport.

SWEETMAN, Jack, Associate Professor, "Command of the Sea," *The Vietnam Experience: Flags into Battle*. eds. Michael Casey, Clark Dougan, Samuel Lipsman, et. al. Boston: Boston Publishing Co., 1987, pp. 168-185.

This chapter presents a concise history of U.S. naval operations during the Vietnam conflict. Although it centers on the period during which American forces engaged in combat (1965-1973), its introductory section traces the origins of U.S. naval involvement in Vietnam back to the activation of the Navy Section of the Military Assistance and Advisory Group, Indo-China, in 1950. The chapter reviews the full spectrum of naval activities in Vietnam, extending from the coastal and riverine missions of the Brown Water Navy to carrier air operations, shore bombardment, amphibious landings, the advisory program, and medical and logistical support. Research in printed materials was supplemented by interviews with officers who served in Vietnam.

SWEETMAN, Jack, Associate Professor, Series Editor, "Classics of Naval Literature," Naval Institute Press.

This series, inaugurated by the Naval Institute Press in 1984, is designed to provide attractive new edi-

tions of classic works of naval history, biography, and fiction. In addition to the unabridged original text, each work includes a substantial introduction and, when appropriate, explanatory notes by an expert in the field. Some editions also contain new illustrations and maps. The following works appeared during this reporting period:

Theodore Roosevelt, *The Naval War of 1812*. Introduction by Edward K. Eckert.

Thomas B. Buell, *The Quiet Warrior: A Biography of Admiral Raymond A. Spruance*. Introduction and notes by John B. Lundstrom.

Richard Pearson Hobson, *The Sinking of the "Merrimac."* Introduction and notes by Richard W. Turk.

Herman Melville, *White-Jacket*. Introduction by Stanton B. Garner.

SYMONDS, Craig L., Professor, ed., *A Year on a Monitor and the Destruction of Fort Sumter*, Alvan F. Hunter. Columbia, South Carolina: University of South Carolina Press, 1987.

This is a memoir by a sixteen-year-old volunteer on a Union ironclad during the American Civil War; edited, annotated, and with an introduction by the researcher.

## Presentations

ARTIGIANI, P. Robert, Associate Professor, "Is Military Science Possible?", U.S. Naval War College, Newport, Rhode Island, 9 July 1987.

ARTIGIANI, P. Robert, Associate Professor, "Instrumentation and Revolution in Science," Headquarters of LABCOM, Natick, Massachusetts, 17 August 1987.

BOGACZ, Theodore W., Associate Professor, "Battleshock: Past, Present, and Future," Department of War Studies Staff, Royal Military Academy, Sandhurst, England, 14 July 1987.

BOGACZ, Theodore W., Associate Professor, "Anti-Modernism in English Culture in the 19th and 20th Centuries," University of Cambridge/UCLA Summer Course, Cambridge, England, 27 July 1987.

CALDERHEAD, William L., Professor, "Thomas Carney: Unsung Black Soldier of the American Revolution," Conference on Blacks and the Constitutional Era in Maryland: 1776-1810, Annapolis, Maryland, 1-2 October 1987.

CALDERHEAD, William L., Professor, "Slave Breeding in the Old South: A New View Based on Statistical Evidence," Missouri Valley History Conference, 11 March 1988.

COGAR, William B., Assistant Professor, "The Trinity House and the Naval Revolt of 1648," Annual Conference of the North American Society for Oceanic History, Woods Hole, Massachusetts, 30 April 1988.

CULHAM, Phyllis, Associate Professor, "Roman Expansion in Northern and Central Italy," Virginia Classical Association, Charlottesville, Virginia, 12 October 1987.

CULHAM, Phyllis, Associate Professor, "Choices, Constraints, and Chaos: Error and Failure in Ancient Military History," Conference on Error and Failure in Ancient Military Engagements, Columbus, Ohio, 5 February 1988.

CULHAM, Phyllis, Associate Professor, "Pouvoir and Savoir: Mediated Autobiographies of Female Mystics in Medieval Italy," Conference on Ecriture et Langage, Dubrovnik, Yugoslavia, 7-14 May 1988.

CUTLER, Thomas J., Lieutenant Commander, USN, "Teaching the Vietnam War," Norwich University Graduate Seminar, Montpelier, Vermont, 13 February 1988.

DECREDICO, Mary A., Assistant Professor, "War is Good Business: Georgia's Urban Entrepreneurs and the Confederate War Effort," Southern Historical Association Annual Meeting, New Orleans, Louisiana, 13 November 1987.

Ellenberger, Nancy W., Associate Professor, "The Souls in Power: the Failures of a Political Clique," North American Conference on British Studies, Portland, Oregon, 5 November 1988.

GOOD, Jane E., Associate Professor, "E.X. Breshkovskaia's Anti-Bolshevik Crusade," American Association for the Advancement of Slavic Studies Annual Meeting, Boston, Massachusetts, 5 November 1987.

HAGAN, Kenneth J., Professor, "Men, Machines, and Maritime Strategy: A Reconsideration of the American Navy, 1801-1898," First International Colloquium on Naval History, Athens, Greece, 25 August 1987.

PEELER, David P., Assistant Professor, "Before Eden: Edward Weston, Ansel Adams and Primal Stuff," Center for Creative Photography, Tucson, Arizona, 23 June 1987.

PEELER, David P., Assistant Professor, "The Meaning of Form: West Coast American Photography," Aesthetics Seminar at the Pennsylvania State University, Harrisburg, Pennsylvania, 9 November 1987.

QUARTARARO, Anne T., Associate Professor, "The Domestic Ideal and Women Schoolteachers in Nineteenth Century France," Society for French Historical Studies Meeting, University of South Carolina, Columbia, South Carolina, 21 March 1988.

SWEETMAN, Jack, Associate Professor, "The U.S. Navy Enters the Age of Steam, 1814-1861," First International Colloquium on Naval History, Athens, Greece, 25 August 1987.



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Division of  
Mathematics and Science



# Chemistry

Professor Charles F. Rowell  
Chairman

This reporting period represents one of significant change. We have added five new tenure-track professors who bring both youth and enthusiasm to the research effort. They bring with them research interests that range from solid state chemistry and ceramics, through polymers, to natural products chemistry. We also have added a spectroscopist who carries out research in inert matrices at very low temperature.

One of the most productive researchers in our department has been Tom Bitterwolf. Without doubt, his activities, which have included collaborations which cover the United States and Europe, have given USNA positive exposure and excellent reputation. The scope of his contribution is well illustrated in this year's report (5 papers and 13 presentations). In the fall of 1988, he will become a professor at the University of Idaho, where he will continue the intellectual productivity that has impressed us all.

The statistics for the year are good. Twenty-nine significant presentations, eighteen publications including a patent, about half of the chemistry majors in the graduating class involved in research, and new contacts being made with both Navy and industrial sources are signs of health in the enterprise.



## Sponsored Research

### Effects of Phosphine and Phosphite Ligands on the Chemistry of Arene Chromium Carbonyl Complexes

Researcher: Associate Professor Thomas E. Bitterwolf

Sponsor: National Research Council of Italy

Arene chromium tricarbonyl compounds are receiving considerable attention because of their potential to serve as intermediates in the synthesis of complex organic compounds. Introduction of a chromium tricarbonyl onto an aromatic ring alters the chemical behavior of the ring, so that nucleophilic substitution reactions can be conducted under mild conditions. The present research is directed toward an understanding of the consequences of introducing electron donating groups

onto the chromium atom, so that the electron density alterations of the arene ring are fine tuned.

This joint collaborative project between the USNA and the University of Padova is entering its fifth year and has resulted in significant progress in the study of haptotropic rearrangements of chromiumcarbonyl-substituted fluorene compounds and the generation of previously unknown anions and dianions of compounds containing two chromium groups.

### Matrix Isolation Photochemistry of Organometallic Compounds

Researcher: Associate Professor Thomas E. Bitterwolf

Sponsor: Naval Academy Research Council (ONR)

Chemical reactions in which high energy light is used to generate reactive intermediates are called photochemical reactions. In organometallic chemistry these kinds of reactions are particularly valuable, because they can be used to generate new compounds which cannot be obtained by other routes. Much of the preparative chemistry being conducted at the Naval Academy uses photochemical reactions as a critical part of the process. This

high dependence on photochemistry has compelled the initiation of a program directed toward examining the intermediates generated by photolysis. In collaboration with Professor Anthony Rest of The University, Southampton, England, examination of the intermediates formed in several reactions has been successfully completed and new problems begun.

## Electrochemical Measurement Strategies for Determination of Species in Non-Conducting Media

Researcher: Associate Professor Graham T. Cheek

Sponsor: Naval Research Laboratory, Code 6170

The object of this research is the development of a simple, reliable test for antioxidant determination in lubricating oils used by the Navy. Electrochemical methods have been used to monitor oxidation currents arising from the presence of various antioxidants in test mixtures. Due to the low conductivity of these solutions, microelectrodes have been employed in this investigation.

Electrochemical measurements were attempted in the lubricating oils (Hercolube) themselves. This medium was found to be very resistive and supported no current flow even at the picoampere level using a 10 micrometer (diameter) platinum electrode. Addition of tetra-*n*-hexylammonium benzoate as supporting electrolyte enabled oxidation currents due to phenothiazine and diphenylamine to be observed and measured; however, solution preparation was very inconvenient and produced a very viscous solution which made electrode manipulation and cleaning very difficult.

Subsequent approaches have involved the mixing of lubricating oil/antioxidant mixtures with acetonitrile (1:5 ratio) to provide adequate conductivity for meaningful electrochemical measurements. The conductivity in this case arises from trace impurities in the acetonitrile and is sufficient to enable well-defined oxidation plateaus to be observed, although these responses are somewhat

distorted by iR drop in the solution. In order to improve further the character of these responses, a counter electrode arrangement was devised in which the 1 mm (diameter) platinum counter electrode could be positioned to within approximately 0.1 mm of the microelectrode, effectively eliminating the iR drop and its effect on the electrochemical responses. One disadvantage of this approach is that the potential reference provided by the counter electrode (pseudo-reference electrode) is not particularly stable. In the approach currently followed, a fritted-barrier cell is employed, one side being filled with the acetonitrile/lubricating oil solution and the other side containing an aqueous 0.1 M  $\text{NaClO}_4$  solution. A commonly used reference electrode, such as a silver/silver chloride reference electrode, is placed in the aqueous side of the cell and provides a stable potential reference. The small amount of leakage of electrolyte from the aqueous side of the cell into the test solution provides very good conductivity, as evidenced by the undistorted current plateaus obtained for antioxidant oxidation. Calibration curves for current response for oxidation of phenothiazine and phenyl-*l*-naphthylamine have been linear over the concentration range 0.10% to 2.00% of these components (in original oil solution, before acetonitrile addition).

## Crystal Structure Determinations of Energetic Materials

Researcher: Assistant Professor Douglas S. Dudis

Sponsor: Naval Research Laboratory, Code 6030

Precise molecular parameters, including the distances between individual atoms and the angles between the atoms, can be obtained from single crystal diffraction experiments. The picture of a molecule that results is valuable to the synthetic chemist in that it unambiguously determines the identity of a substance. For the theoretician, such information provides accurate molecular experimental parameters against which theoretical calculations can be compared. Studies of biological materials often reveal details which indicate their mode of action (e.g., for enzymes). Of interest to this project, such data can be used to make

structure-reactivity correlations which aid in the design of new materials with desired properties.

The crystal and molecular structures will be determined for a number of organic molecules. Most of the compounds examined will be high energy materials of interest as either explosives or propellants. Materials provided in suitable crystalline form will be studied promptly, whereas others will require recrystallization. The structures of these molecules may be of value for molecular and quantum mechanical studies. Many of the compounds may be crowded or strained, thus having unusual molecular parameters.

## Potential Surface for The Collinear Reaction of Condensed-Phase Nitric Oxide

Researcher: Associate Professor Mark L. Elert  
Sponsor: Naval Research Laboratory, Code 6119

In order to perform a realistic molecular dynamics simulation of detonation, it is necessary to develop a potential energy surface for the reactant species which incorporates bond-breaking and bond-forming reactions. Pair potentials are not sufficient for this purpose, since the force between a given pair of atoms must depend on the number of bonds already formed to the two atoms under consideration.

A technique has been developed for applying the LEPS (London, Eyring, Polanyi, Sato) three-body potential formalism to the problem of a one-dimensional array of diatomic molecules, in a form

such that the reaction

$\dots\text{NO ON NO ON}\dots \rightarrow \dots\text{N OO NN OO N}\dots$

can be accurately modeled. The potential correctly incorporates weakly attractive van der Waals interactions among nonbonded species, insuring stability of the initial crystal. It also produces the correct initial, transition, and final state energies for the processes  $\text{NO} + \text{O} \rightarrow \text{N} + \text{O}_2$  and  $\text{N} + \text{NO} \rightarrow \text{N}_2 + \text{O}$ .

This potential surface has been used as the basis for molecular dynamics simulations of the detonation of condensed-phase nitric oxide.

## Studies of Reactive Molecular Fragments by Matrix-Isolation Spectroscopy

Researcher: Assistant Professor Robert F. Ferrante  
Sponsor: Naval Academy Research Council (ONR)

The purpose of this project is to use the matrix-isolation technique to prepare, identify, and spectroscopically characterize a number of highly reactive intermediates called nitrenes. These reactive molecular fragments are frequently implicated as participants in some well-known chemical reactions, but there is little direct evidence for their existence in most cases because of their high reactivity. The technique of matrix-isolation, in which a reactive fragment is condensed into an inert solid solvent cage at extremely low (10 K) temperatures, allows one to prepare and maintain these radicals in an environment that prevents further reaction by eliminating diffusion. Spectroscopic characterization of the trapped radicals can help demonstrate their involvement in reaction mechanisms as well as lead to theoretical insights on the structure and bonding in these unusual species.

Preliminary evidence has been obtained on a number of these radicals which can be prepared

from a stable parent azide by bombardment with excited molecular nitrogen. In this reporting period, the low temperature equipment for the matrix experiments has been reassembled and tested, as has the vacuum rack used in production of the parent azides and preparation of gas mixtures. FT-IR experiments on trimethylsilylnitrene and acetyl nitrene have begun.

A concurrent theoretical investigation into the correlation of experimental parameters for a series of new and known nitrenes is also underway. Semi-empirical MO calculations have been performed on several nitrenes of interest, and the expected variation in the D (zero-field splitting) value has been observed. These calculations are continuing on more complicated nitrenes. More sophisticated models that can be performed on the department's new VAX computer are also under development.

## Property Testing of Invert Hydraulic Fluids

Researcher: Associate Professor Frank J. Gomba  
Sponsor: David Taylor Research Center, Annapolis Laboratory

In the search for fire-resistant hydraulic fluids, a number of materials and mixtures have been proposed, developed, and found satisfactory for gross performance characteristics. The further elaboration of secondary characteristics such as corro-

siveness, paint and filter compatibility, and other shelf-life and in-service aspects needs to be done. This work was a start in that direction with the strategy of modifying established ASTM procedures as the major thrust.

## Studies of The Total Syntheses of Dolabellane Diterpenes

Researcher: Assistant Professor Debra K. Heckendorf  
Sponsor: Naval Academy Research Council (ONR)

A strategy for the synthesis of members of the dolabellane class of diterpenes will be investigated in this research. The proposed approach to these biologically-active natural products focuses on stereoselective synthesis of the diterpene ring system. This is being investigated utilizing an initial stereoselective synthesis of a trisubstituted five-membered carbocyclic ring. Once this ring is constructed, an eleven-membered ring will be appended to produce the basic dolabellane ring system. The initial synthetic target is the diterpene

dolabelladiene, which is envisioned as a precursor to the other members of the class of compounds. Once this target has been accomplished, additional elaboration of dolabelladiene will be undertaken to synthesize other dolabellanes.

Nuclear magnetic resonance will be utilized to identify and characterize intermediates. Computer modelling will be utilized to predict both the geometry of the advanced intermediates containing the eleven-membered carbocyclic ring and the outcome of reactions of these intermediates.

## Photoenolization of Ortho-Alkylacylhetocycles

Researcher: Assistant Professor William T. Lavell  
Sponsor: Naval Academy Research Council (ONR)

While the photoenolization of ortho-alkylacyl-heterocycles has been well-studied both in mechanism and synthetic application, the process in similar aromatic heterocycles has been investigated considerably less. Such heterocycles are generally easy to synthesize and could be convenient intermediates for the synthesis of more complex molecules. Thus, the purpose of this investigation is to define the limits in which photoenolization can occur in heterocyclic substrates.

Initially, the study will be limited to photoenolization in indoles; the substrates are easily

synthesized using established methodology, and if photoenolization is found to occur, the method could be used to synthesize a large number of members of the ellipticine and olivacine families of alkaloids. Later studies will focus on the ease of photoenolization as a function of resonance stabilization energy in pi-deficient and pi-excessive heterocycles (for example: pyrrole vs. indole; pyridine vs. quinoline; furan vs. thiophene), and as a function of the nature of the photoexcited state (pi-pi\* vs. n-pi\*; singlet vs. triplet pi\*).

## CHEMISTRY

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### Quenching of Terbium Complexes

Researcher: Associate Professor Robert G. Linck  
Sponsor: Naval Academy Research Council (ONR)

The quenching of excited states of metal ions by other metal ion complexes is susceptible to theoretical analysis; it has, therefore, been an area of considerable interest. In this project the researcher has investigated the quenching of some Tb(III) complexes by Co(III) complexes of ethyl-

enediamine and 1,2-diaminocyclohexane. The objective was to ascertain if the increased size of the cyclohexane derivative was sufficient to slow the quenching reaction. The rate constants for both become diffusion-controlled as the ionic strength is lowered. Further experiments are in progress.

### Low Temperature Syhthesis of Transition Metal Sulfides

Researcher: Assistant Professor Joseph F. Lomax  
Sponsor: Naval Academy Research Council (ONR)

Metal sulfides are important as high energy density battery cathodes and as hydrodesulfurization catalysts. They are typically made by high temperature (<700° C) combination of the elements. The researcher is attempting to develop a low temperature route to these important compounds by the reaction of metal alkoxides with

hydrogen sulfide. In some cases, the metal alkoxides are commercially available (e.g. Titanium iso-propoxide); however, some of the starting alkoxides will need to be prepared according to known methods. In developing these techniques, safety and high purity are of great importance.

### Electron Density Determination in Simple Inorganic Oxy-Anions

Researcher: Assistant Professor Wayne H. Pearson  
Sponsor: Naval Academy Research Council (ONR)

This research project involves the determination of electron densities in simple oxy-anions by X-ray diffraction techniques. The interest in these compounds is the degree to which  $d$  orbitals participate in the bonding density. This is important in calibrating the number of theoretical studies which have been performed on such systems over the years and have resulted in differing conclusions regarding  $d$  orbital participation. Preliminary deformation maps constructed for a number of tran-

sition metal oxy-anions indicate qualitatively the presence of  $d$  orbital bonding. The next step is to apply more sophisticated analysis methods to current data in order to determine actual  $d$  orbital populations. An outgrowth of this research is the discovery that the classical R factor test in crystallography for the correctness of an enantiomeric structure may be incorrect. This would be a major finding which would have a good deal of impact on the crystallographic community.

## CHEMISTRY

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### Tin Oxide Formation on Navy Babbitt

Researcher: Professor John W. Schultz  
Sponsor: David Taylor Research Center, Annapolis Laboratory

Under continuous wear, Babbitt metal bearings develop a black oxide under some circumstances. This coating is very hard and influences a number of characteristics of the bearing performance. Experimental studies to determine the details of the

chemical and physical production and service life of the coating were undertaken. A report elucidating the process and its potential control was distributed in the summer of 1988.

### Photochemical Study of Cyano-Isocyanide-Phosphine Complexes of Iron

Researcher: Associate Professor Joyce E. Shade  
Sponsor: Naval Academy Research Council (ONR)

The chemistry of carbonyl-cyano-phosphine complexes of iron has been studied extensively for the last ten years. In general, reflux or photolytic reaction conditions have been employed to initiate the loss of a carbonyl (CO) group from cyclopentadienyl-iron-carbonyl starting materials with a subsequent inclusion of a phosphine or phosphite ligand on the metal center. The resulting complexes obtained in these studies, however, all contain at least one carbonyl group. The purpose of this research was to prepare a series of anionic, neutral and cationic cyano, mono- and bisisocyanide complexes for reaction with phosphine or phosphite groups under photolytic conditions.

Photolysis of the monoisocyanide complex,  $(C_5H_5)Fe(CO)(CN)(CNCH_3)$ , in the presence of a slight excess of triphenylphosphine at room temperature gave the desired product  $[(C_5H_5)Fe(CN)CNCH_3(PPh_3)]$  with loss of one

equivalent of  $(n^5C_5H_5)Fe(CNCH_3)_2(CN)$  and  $(n^5C_5H_5)Fe(CN)(PPh_3)_2$ . Similar results were obtained with a variety of phosphine, phosphite, arsine, and antimony ligands. Several of the reaction products have been isolated from the fairly clean reaction mixtures, and a variety of spectral data has been obtained to verify their identity. In addition, trends of reaction product yields with bulk and basicity of ligand are being studied. Effect of ligand identity (both on the metal prior to photolysis and as an incoming group), wavelength of the photolysis lamp, and temperature of the reaction mixture are being examined as they affect the reaction products obtained. Anionic and cationic starting materials are being investigated under a variety of reaction conditions in order to analyze the system for any trend which might develop as a function of complex charge.

### Matrix Isolation Photochemistry Studies of Organometallic Complexes

Researcher: Associate Professor Joyce E. Shade  
Sponsor: Naval Academy Research Council (ONR)

Photolysis of carbonyl-cyano-isocyanide complexes in the presence of a potentially incoming ligand results in the loss of the carbonyl group from the starting material and inclusion of the ligand species present in the reaction mixture. A variety of incoming ligands has been investigated and very interesting results have been obtained thus far. In addition to the expected product which contains the cyano-isocyanide-ligand substituents, two additional products have been obtained: one containing two isocyanide groups and one cyano group and a

second product containing one cyano group and two ligand groups. A possible reaction pathway to explain the generation of these species has been suggested. In an effort to characterize the proposed reaction intermediate, a collaborative project has been initiated with Professor Rest at The University, Southampton, England, who is an expert in the field of low temperature matrix isolation studies. Initial results from his lab are very promising, and a probable reaction intermediate has been postulated.

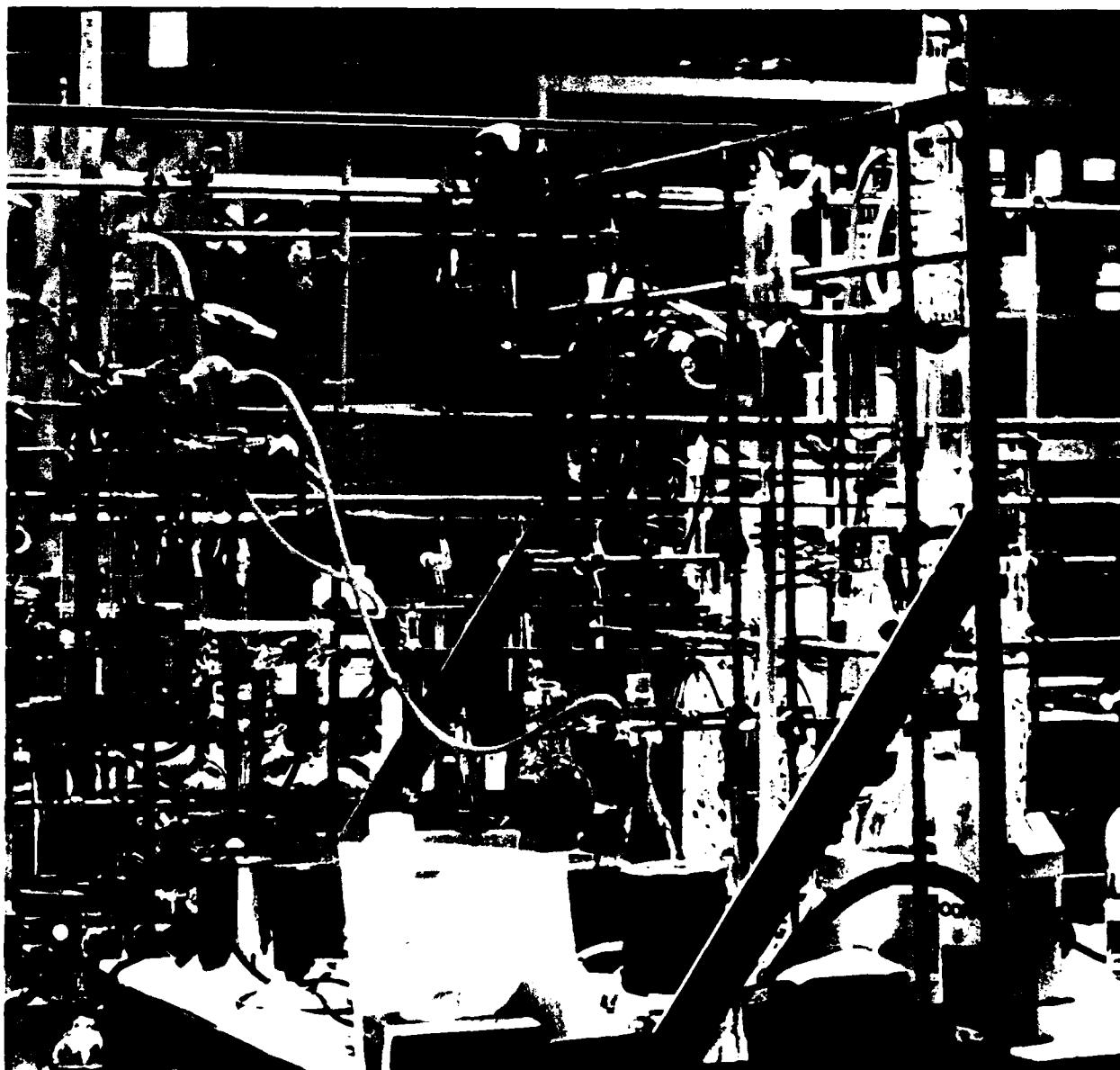
## Theoretical Modeling of Immunolysis Assays

Researcher: Associate Professor Boyd A. Waite  
Sponsor: Naval Research Laboratory

The sandwich assay has great significance for determining the concentration level of antigen. Phospholipid vesicles are decorated with Fab fragments covalently attached to the membrane molecules. Multiple determinant antigen is introduced, one determinant of which (at least) is specific for the bound Fab. A second antibody is introduced, specific to at least one of the other determinants of the antigen. The second bound antibody mediates (through the Fc effector) the

complement pathway, resulting in the lysis of the vesicle, and subsequent detection through fluorescence techniques.

A model is being developed for describing the multiple equilibria established for such an assay system. Minimum detectable concentrations of antigen should be calculable via the model. In addition, experimental tests will be suggested for verifying the suggested mechanisms of complement fixation via such a sandwich structure.



# Independent Research

## Synthesis of Palladium "A" Frame Complexes Using Electron-Withdrawing Ligands

Researchers: Associate Professor Thomas E. Bitterwolf and Ensign John T. Bays, USN

Diphosphine ligands of the general type ( $R_2P$ )- $CH_2-(PR_2)$  have been extensively examined as bridging units in the preparation of dinuclear complexes. Of particular interest are compounds in which two of these diphosphine bridges couple two metal atoms. These complexes are called "A" Frame complexes because of the overall geometry of many of the complexes. Most research on compounds of this type has centered on "R" groups which are electron-donating and which result in high electron densities at the metal atoms. Recent work by Professor Raghubeer has permitted the synthesis of analogous compounds which contain electron withdrawing groups. These new compounds appeared to be ideal for stabilizing complexes of palladium and promoting new reactions not possible with the more electron rich derivatives.

Work during the spring semester of 1987 and the summer of 1987 demonstrated that the new diphosphine ligands form excellent "A" Frame complexes, and that these complexes have reactivities which are different from those of the electron-rich compounds. The preliminary synthetic routes were refined and yields increased to about 80%. It was found that the compounds were stable to column chromatography, permitting easy purification. Crystals were grown and an x-ray crystal structure of these compounds was carried out by Professor Arnold Rheingold of the University of Delaware. Of particular interest was the remarkable decrease in the reactivity of the Pd-Pd bond in these compounds, which is attributed to the strong electron-withdrawing groups on the diphosphine ligand.

## Further Studies of Pentafluorobenzoyl Chloride

Researcher: Associate Professor Graham T. Cheek

The electrolysis products of pentafluorobenzoyl chloride in acetonitrile (at glassy carbon) were found to be a mixture of cis- and transeicosasfluorostilbenediol dibenzoates. Chemical and physical characteristics indicated that the major product (95%) was the trans isomer, and a crystal struc-

ture of the cis isomer, obtained with the help of Dr. Dudis of the Chemistry Department, confirmed this assignment. Interestingly, electrochemical reduction at platinum yields almost equal amounts of the cis and trans isomers.

## Molten Salt Electrochemistry: Fluorenone Reduction in Acidic Melt

Researcher: Associate Professor Graham T. Cheek

In the room-temperature chloroaluminate molten salt system aluminum chloride: 1-methyl-3-butylimidazolium chloride, reduction of fluorenone has been studied at glassy carbon electrodes. As in the basic melt, the reduction product is the pinacolate species; however, in the acidic melt the re-oxidation of the pinacolate back to fluorenone can

be observed in cyclic voltammograms of the system. As is the case with other aromatic ketones in the molten salt, the reduction potentials in the acidic and basic melts are markedly shifted due to complexation of the ketone with aluminum chloride in the acidic melt.

## New 1,1 Dithiolate and 1,2 Dithiolate Ligands and their Metal Complexes

Researchers: Assistant Professor Douglas S. Dudis with  
Robert Rachwald and John Schilling

The reactions of carbon disulfide with a variety of anions are being explored in an effort to prepare new ligands. The preparations of the ligands themselves are important in that they represent C-1 chemistry (i.e., building complicated molecules from simple starting materials). The metal complexes are of interest for a variety of reasons. Analogous compounds have spectroscopic properties, oxidation/reduction potentials, and reactivities that make them industrially important in applications ranging from catalysts to polarizers in sunglasses.

Exploration of the reactions of simple halides with carbon disulfide in a variety of solvents is proceeding. Though conceptually simple, the only study

of this reaction was published in 1984. Modeling these reactions with ab initio calculations is progressing.

The reaction of nitrite ion with carbon disulfide is also under study. It is clear that this reaction (which produces dinitrogen oxide, carbon dioxide, elemental sulfur, sulfide ions, and some, as yet, unidentified products) does not proceed as anticipated. The stoichiometry is not 1:1 but rather 3 carbon disulfides to 4 nitrites. A great deal of spectroscopic data has been obtained which suggests such species as dinitrogen trioxide as intermediates. This project was developed under the Naval Academy Mentorship Program.

## Thioether, Thiol, and Thiolate Complexes of Heavy Metal Porphyrins

Researcher: Assistant Professor Jeffrey P. Fitzgerald

The purpose of this project is to understand the role of the unusual thiolate ligand found in the Cytochrome P-450 enzyme family. The  $RS^-$  ligand is found only in P-450 enzymes. Most other heme-protein are ligated by nitrogen or oxygen atom donors. P-450 enzymes are also the only heme-proteins capable of using molecular oxygen directly to oxidize unactivated substrates. The connection

between the thiolate ligand and the unusual catalytic properties of these enzymes remains unclear.

The mode of investigation is to prepare and study heavy metal porphyrins which contain a sulfur donor in one of their axial coordination sites. The focus of these studies is on the effect of the sulfur ligand on the electronic properties of the metals.

## Hydrolysis of $Fe(TIM)^{2+}$

Researcher: Associate Professor Robert G. Linck

Kinetic studies of the rate of disappearance of  $Fe(TIM)(H_2O)_2^{2+}$  are reported. The rate law is first order in the Fe(II) complex, first order in  $H^+$ , and independent of the concentration of  $Fe(H_2O)_6^{2+}$ , with a second-order rate constant of  $0.178 \pm 0.005 \text{ M}^{-1} \text{ s}^{-1}$  at  $25^\circ\text{C}$  and an ionic strength of 0.5 M. Activation parameters for the reaction were determined to be  $\Delta H^\ddagger = 49.3 \pm 0.9 \text{ kJ/mol}$  and  $\Delta S^\ddagger = -94 \pm 3 \text{ J/(mol deg)}$ . The presence of CO or  $CH_3CN$  in the coordination shell of Fe(II) retards the reaction. This feature allows a deter-

mination of the equilibrium constant for the loss of  $CH_3CN$  from  $Fe(TIM)(CH_3CN)(H_2O)^{2+}$ : The value is found to be  $(2.5 \pm 0.5) \times 10^{-3}$ . Spectral measurements indicate that  $Fe(TIM)(H_2O)_2^{2+}$  has the same electronic structure as the other iron-TIM complexes and, hence, is diamagnetic. The mechanism of the reaction is suggested to involve a displacement of the iron ion from the plane of the macrocyclic ring, promoted by a spin change, followed by hydrolysis of the free ligand.

## Synthesis and Characterization of Organometallic Complexes Using Photochemical Techniques

Researcher: Associate Professor Joyce E. Shade

The chemistry of cationic (pentahaptocyclopentadienyl) (olefin) iron dicarbonyl complexes and their subsequent reaction with a variety of nucleophiles at the olefinic position to produce stable sigma-bonded alkyliron complexes has been studied extensively. Little work has been done, however, with ruthenium analogues of this system. The purpose of this research was the synthesis and characterization of several ruthenium carbonyl-olefin-isocyanide (CNR) complexes. A series of anionic, cationic, and neutral ruthenium (CNR) groups has been synthesized. Photolytic decar-

bonylation of these complexes in the presence of ethylene gas at 5°C produced two complexes:  $[(C_5H_5)Ru(CNCH_3)(ethylene)_2]PF_6$  and  $(C_5H_5)Ru(CN)(ethylene)_2$ . Both complexes have been separated from the reaction mixtures and spectral data have been obtained to confirm their identity. Additional reactions of ethylene gas, as well as propylene gas, with a variety of starting materials is underway in order to compare reactivities of the gases toward the starting materials. In addition, temperature and solvent dependence studies are being conducted.

## Haptotropic Rearrangement of Fluorene Chromiumdicarbonyl Phosphine Compounds

Researcher: Associate Professor Joyce E. Shade

Organic compounds such as anthracene, phenanthrene, and a fluorenyl anion are multicarbon compounds consisting of fused carbon rings. There exist in these compounds two distinct aromatic centers through which a transition metal-containing substituent might be bound. In several systems, it has been determined that the metal can migrate from one aromatic center to the other, since this migration is known to have a small activation barrier. In chromiumtricarbonyl systems, for example, which are bound to fluorene, the metal is bound to the normal six-membered ring. Upon dehydrogenation of one of the methylene hydrogens, a fluorenyl anion is generated and there is the migration of the metal to the newly formed five-membered ring. The Italian research group of Professor Ceccon in Padua has investigated this fluorenyl system and other related compounds.

Being investigated in this project is the effect on the metal migration between the two aromatic rings as the identity of the ligand substituents on the metal itself is varied. One method to measure such an effect is to introduce a phosphine or phosphite ligand onto the metal in place of a carbonyl group. Phosphorous-containing ligands are known to affect the amount of electron density on the metal which, in turn, affects the bonding preference of the metal for the different ring systems. To study this effect, a series of fluorenechromiumdicarbonyl-phosphine derivatives has been prepared, the haptotropic rearrangement studies conducted, and spectral data collected on all compounds at various stages of the rearrangement studies.

## Diet and Growth in the Crayfish, Procambarus Clarki

Associate Professor D. Lawrence Weingartner

It was noticed that the swamp crayfish, Procambarus Clarki, seemed to include more plant material in its diet than other crayfish species known to the researcher. To study the ability of this crayfish to sustain itself and grow on plant food, newly hatched crayfish were divided into three dietary groups: (1) food consisting of various aquatic plants; (2) food consisting of various aquatic animals; and (3) food consisting of both plants and animals.

After six months, the results indicate that the best growth, especially in the younger stages, is achieved

from a complete diet of both plant and animal material. Crayfish maintained on a strictly animal diet underwent slower growth initially, but in the last few months have caught up with the crayfish on complete diets. The crayfish maintained on plant food grew very slowly during the first few months, but of late have ceased all growth and are experiencing a higher mortality rate.

The experiment continues to determine how diet affects the attainment of sexual maturity and fertility.



## CHEMISTRY

## Research Course Projects

# Metallophthalocyanines as Homogeneous Oxidation Catalysts

Researcher: Midshipman 1/C Kristen A. Bakkegard, USN  
Adviser: Assistant Professor Jeffrey P. Fitzgerald

The objectives of this project are twofold: first, to prepare soluble metallocetetraazaporphyrins; and second, to study their properties as homogeneous oxidation catalysts. It is desired to compare the physical and catalytic properties of tetraazaporphyrins to the naturally occurring porphyrins. This may lead to greater understanding of bonding and catalysis in the natural system and to the development of more selective or more stable catalysts.

Preliminary results indicate the initial goal, development of a short, high-yield synthesis of soluble tetraazoporphyrins, has been achieved. Diphenylmaleonitrile may be obtained from commercial sources in one step. Heating this material to 275°C in the presence of zinc powder yields a deep green substance which has been characterized as zinc octaphenyltetraazaporphyrin. This material is readily soluble in polar organic solvents.

# The Synthesis of Heterocyclic Thiosemicarbazones for Testing as Antiviral Agents

Researchers: Midshipmen 1/C Marjorie F. Canby, Brian A. Colley, and  
Andrew S. Johnson, USN  
Adviser: Professor Samuel P. Massie

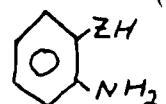
Studies were carried out by the three midshipmen directed at the preparation of heterocyclic thiosemicarbazones of the general formula



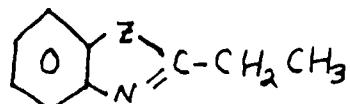
where  $R_1$  and  $R_2$  were pyrrolidyl,  $R_3$  and  $R_4$  were derived from methyl ketones. These thiosemicarbazones were synthesized for testing against viral diseases, especially AIDS.

They were prepared by the reaction of pyrrolidine,  $\text{CS}_2$ , and KOH with subsequent reaction with chloroacetic acid to yield the thioglycolic acid. This was then reacted with hydrazine hydrate and NaOH to form pyrrolidyl thiosemicarbazide, which subsequently was reacted with 2,3,4 trimethoxyacetophenone, 3,4,5-trimethoxyacetophenone, and 4-cyanoacetophenone to yield the corresponding thiosemicarbazones. (Each midshipman carried out two of these three reactions, so as to provide cross-checks.)

Since heterocyclic methyl ketones were desirable as the ketone ( $R_3, R_4$ ) component of the last step, it was proposed to react aniline derivatives of the general formula  $(Z=O, NH, S)$  with



excess propionic anhydride to form the corresponding 2-ethyl derivatives.



which could then be oxidized to the corresponding methyl ketones. These studies were begun with 2-amino phenol, but were not completed.

Infrared studies of the intermediate compounds were made. A brief survey of the chemistry and biology of viral diseases was also made.

## Molecular Simulation of Detonation

Researcher: Midshipman 1/C Eric A. Laing II, USN  
Adviser: Associate Professor Mark L. Elert

A computer simulation of the one-dimensional detonation reaction  $2\text{NO} \rightarrow \text{N}_2 + \text{O}_2$  was carried out by simulating the impact of a short chain of NO dimers on a larger slab of the same material at various relative speeds. A realistic three-body potential surface was used to predict the motions of individual atoms, properly accounting for endothermic bond-breaking and exothermic bond-forming reactions.

Several simulations were carried out with impact velocities ranging from 2 km/sec to 8 km/sec. A critical incident velocity between 3 and 4 km/sec was found to be necessary to initiate sustained

detonation. Above that threshold, the speed of the detonation front through the material was found to be remarkably constant at 15 km/sec. Additional simulations were carried out with scaled atomic masses to determine the effect of mass on detonation velocity.

In order to monitor the progress and properties of the simulations, a program was written to display the atomic positions versus time as an animated sequence on a high-resolution graphics display station. A videotape of selected segments of the simulations was produced.

## Synthesis and Photochemistry of Dinuclear Ruthenium Complexes with Pyrazole as a Bridging Ligand

Researcher: Midshipman 1/C Keith E. Miller, USN  
Adviser: Associate Professor Thomas E. Bitterwolf

A recent literature report (J.A. Cabeza, C. Landazuri and L.A. Oro, *Journal of Organometallic Chemistry*, **322** (1987), C16) described the synthesis of an interesting new dinuclear ruthenium complex,  $\text{Ru}_2(\text{CO})_6(\text{u-Pz})_2$ , where u-Pz is a bridging pyrazolate ligand. This complex appeared to be an ideal candidate for photolysis studies, in which it might be expected that a carbonyl ligand could be

photochemically removed and replaced by other ligands. An alternate route to the desired ruthenium complexes using readily available ruthenium carbonyl starting materials and pyrazole was developed. Photolysis of these complexes in the presence of triphenylphosphine resulted in the formation of a new species which has not yet been fully characterized.

## Fouling Agents: Environment Necessary to Support Life Possible Chemicals Excreted

Researcher: Midshipman 1/C Jason J. Ross, USN  
Adviser: Professor R. Reece Corey

Two strains of periphytic bacteria were isolated from the water of the Severn River. Periphytic bacteria are those which grow attached to surfaces and are the pioneer species in the fouling of surfaces. In nutritional studies, these bacteria were found to grow on glass slides submerged in Severn River water but not on slides in artificial sea water isotonic with Severn River water. The addition of dextrose & glycerine was sufficient to support growth in artificial sea water. The addition of vitamins and other amino acids did not increase

growth. The presence of a bacterial growth film on submerged surfaces appears to attract other fouling organisms. Analyses were performed on artificial sea water solutions in which the bacteria had grown, to determine if they produced a substance which had activity as a pheromone. Spectrophotometry and paper chromatography were employed for identification. A substance was detected that appeared to be an amino acid or amino acid-like compound, but complete identification has not yet been completed.

## Electrochemical Studies of Fluorine-Substituted Aromatic Compounds

Researcher: Midshipman 1/C Patrick R. Steele, USN  
Adviser: Associate Professor Graham T. Cheek

The electrochemistry of several fluorinated aromatic compounds in acetonitrile was studied in order to assess the effect of fluorine substitution upon the electrochemical pathways of these systems. Initial studies were carried out using the technique of cyclic voltammetry to determine characteristic potentials for the systems, followed by preparative electrolysis at these potentials to produce sufficient product for study by chromatographic and spectroscopic methods. It has been found, by comparing the electrochemical behaviors of the fluorinated compounds with those of their parent (non-fluorinated) compounds, that fluorine substitution generally destabilizes the anion radicals generated upon electrochemical reduction. In the case of nitrobenzene, it was found that the anion radical resulting from one-electron reduction was stable for at least several seconds, as judged from the completely reversible behavior seen in cyclic voltammograms at 100 mV/s. Cyclic voltammo-

grams of pentafluoronitrobenzene, however, showed reversible behavior only at 2 V/s, indicating that the half-life of this anion radical is less than one second. Other systems studied included pentafluoroaniline, the oxidation of which produced decafluoroazodecafluoroazobenzene, suggesting that a radical species is involved in a coupling process to give the observed product. Electrochemical reduction of bromopentafluorobenzene gave pentafluorobenzene, affecting the substitution of hydrogen for bromine. In some cases, observation (by mass spectrometry) of less than five fluorine atoms per aromatic ring in electrolysis products indicated that elimination of fluoride from initially generated radical species is taking place. These studies have provided valuable information about the electrochemistry of fluorinated systems and are expected to serve as an introduction to more detailed work in the future.

## Time Dependent Studies of the Direct Binding Model for Vesicle Immunolysis Assay

Researcher: Midshipman 2/C Joel D. Stewart, USN  
Adviser: Associate Professor Boyd A. Waite

A multi-equilibrium model has been developed previously for describing the binding of monovalent antibodies to vesicles decorated with  $n$  monovalent receptor sites. These studies allowed for the determination of the minimum number of antibodies required to initiate the lysis via the complement pathway. The present study attempts to describe the same antibody binding using standard kinetic modeling; i.e., by integrating the coupled differential equations which govern the

binding of the monovalent antibodies to the  $n$  monovalent receptor sites per vesicle. Results indicate a monotonic approach to the equilibrium values, thus precluding the possibility of anomalous transient behavior for the monovalent case. It is expected, however, that for the multivalent antibody direct binding model, there may still be anomalous transient behavior giving rise to pre-equilibrium lysis of vesicles.

## The Divalent Antibody Direct Binding Model: On the Requirement for the Attachment of Both Binding Sites in Immunolysis Assays

Researcher: Midshipman 1/C Scott E. Wilson, USN  
Adviser: Associate Professor Boyd A. Waite

A recently developed model for describing the binding of divalent antibodies to monovalent receptor sites decorated on the surface of phospholipid vesicles is evaluated to determine the possibility of suggesting certain experimental methods which address the requirement of multiple-binding of the attaching antibodies in the initiation of the complement lytic pathway. Results indicate that by approaching high antibody concentrations,

the primary attachment mode is monovalent; i.e., antibody ligands generally have one bound site, the other site remaining free. Thus, if multiple-site attachment is a requirement for the initiation of the complement lysis mechanism (due to a stricter conformational arrangement of the Fc tails of the effector antibodies), it should be possible at high concentrations of antibody to see a fall-off of the lytic activity.



# Publications

BITTERWOLF, Thomas E., Associate Professor, co-author, "Mixed-Valent Cations of Dinuclear Chromium Aryl Complexes: Electrochemical, Spectroscopic, and Structural Considerations," *Journal of American Chemical Society*, **109** (1987), 5680.

The oxidation of a series of six dinuclear chromium carbonyl complexes linked by a biphenyl ligand and/or diphenylphosphino-(or arsino-) methane moiety has been studied by electrochemistry, infrared spectroscopy, electron spin resonance spectroscopy, and X-ray crystallography. Comparison is made with four mononuclear analogues. Each dinuclear complex shows two successive one-electron oxidations, with the separation of  $E^\circ$  values varying from a low of 160 mV for  $[(\text{benzene})\text{Cr}(\text{CO})_2]_2(\mu\text{-dppm})(\text{dppm})$  (dppm = diphenylphosphinomethane) to a high of 550 mV for  $(\text{biphenyl})[\text{Cr}(\text{CO})_2]_2(\mu\text{-dppm})(\text{dppm})$  (dppm = dimethylphosphinomethane). The monocation derived from  $(\text{biphenyl})[\text{Cr}(\text{CO})_2(\text{PPh}_3)]_2$  displays IR and ESR spectra indicative of a charge- and spin-localized mixed-valent complex. Complexes with both a biphenyl and diphenylphosphino- or arsino-methane linkage are valence-delocalized, judging from IR and ESR spectra. Neutral  $(\text{biphenyl})[\text{Cr}(\text{CO})_2]_2(\mu\text{-dppm})$  (8) has a severe twisting of the phenyl rings, the torsion angle being 50.8°. However, the torsion angle relaxes to 3.7° in the monocation. (8<sup>+</sup>) Nutral (8) crystallizes in the space group  $\text{P}1$  with  $a = 9.606(3)\text{\AA}$ ,  $b = 13.530(3)\text{\AA}$ ,  $c = 18.774(8)\text{\AA}$ ,  $\alpha = 76.57(3)^\circ$ ,  $\beta = 78.88(3)^\circ$ ,  $\gamma = 70.04(3)^\circ$ , and  $Z = 2$ . Cationic (8<sup>+</sup>)  $[\text{PF}_6]^-$  crystallizes in the space group  $\text{C}2/c$  with  $a = 34.353(9)\text{\AA}$ ,  $b = 11.185(2)\text{\AA}$ ,  $c = 31.011(9)\text{\AA}$ ,  $\beta = 126.18(2)^\circ$ , and  $Z = 8$ .

BITTERWOLF, Thomas E., Associate Professor, and Joyce E. SHADE, Associate Professor, co-author, "Metal-Stabilized Carbanions IX: The Influence of Metal Basicity on the  $n^6\text{-}n^5$  Haptotropic Equilibrium of (Fluorenyl)- $\text{Cr}(\text{CO})_2\text{L}$  Anions," *Journal of Organometallic Chemistry*, **327** (1987), 55.

The haptotropic rearrangement of  $n^6$ -fluorene- $\text{Cr}(\text{CO})_3$  complexes to  $n^5$ -fluorenyl- $\text{Cr}(\text{CO})_3$  complexes upon removal of a methylene hydrogen has been examined by several workers. In this paper, the authors examine the effect of increasing metal electron density on this rearrangement pro-

cess. A series of  $n^6$ -fluorene- $\text{Cr}(\text{CO})_2\text{L}$  complexes has been prepared where  $\text{L} = \text{P}(n\text{-Bu})_3$ ,  $\text{PPh}_3$ , and  $\text{P}(\text{OPh})_3$ . The C-H acidity of these compounds has been measured and it has been found that the acidity decreases as the electron donating ability of the phosphine or phosphite ligand increases. Measurements of the  $n^6\text{-}n^5$  haptotropic rearrangement demonstrate that the position of this equilibrium is strongly affected by increased electron density on the metal. For electron donating phosphine ligands, the  $n^6$  species is favored, while for the parent  $\text{Cr}(\text{CO})_3$  complexes, the  $n^5$  species is preferred.

BITTERWOLF, Thomas E., Associate Professor, co-author, "Synthesis and Molecular Structure of a Dirhodium Complex of Bis(cyclopentadienyl)methane Containing a  $\mu$ -Methylidene Bridge:  $\text{CH}_2[\text{C}_5\text{H}_4\text{Rh}(\text{CO})]_2\text{-}\mu\text{-CH}_2$ ," *Organometallics*, **6** (1987), 2138.

A novel dirhodium  $\mu$ -methylidene complex,  $\text{CH}_2[\text{CpRh}(\text{CO})]_2\text{-}\mu\text{-CH}_2$ , has been prepared by reaction of  $\text{CH}_2[\text{CpRh}(\text{CO})]_2\text{-}\mu\text{-CO}$  and N-methyl-N-nitrosourea in refluxing benzene. The compound has been fully characterized by elemental analysis, infrared,  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectroscopies, and by an X-ray crystallographic analysis;  $\text{C}_{14}\text{H}_{12}\text{O}_2\text{Rh}_2$ ; orthorhombic  $\text{Pnma}$ ,  $a = 15.234(3)$ ,  $b = 13.940(2)$ ,  $c = 6.013(1)$   $\text{\AA}$ ,  $V = 1276.9(4)$   $\text{\AA}^3$ ,  $Z = 4$ ,  $R_f = 2.84\%$ . The molecular structure of the  $\mu$ -methylidene complex has been found to be isomorphous with that of  $\text{CH}_2[\text{CpRh}(\text{CO})]_2\text{-}\mu\text{-CO}$ , which has recently been reported.

BITTERWOLF, Thomas E., Associate Professor, co-author, "Dimerization of a 17-Electron Cation Radical by Formation of a Rhodium-Rhodium Bond," *Organometallics*, **7** (1988), 567.

$\text{CpRh}(\text{CO})\text{L}_2$ ,  $\text{L} = \text{PMe}_3$  or  $\text{P}(\text{OPh})_3$ , oxidize by one electron to form dinuclear dication of the type  $[\text{CpRh}(\text{CO})\text{L}]_2^{2+}$ . In contrast to the previously studied  $\text{L} = \text{PPh}_3$  system, which oxidizes to a fulvalene complex, the  $\text{PMe}_3$  and  $\text{P}(\text{OPh})_3$  derivatives dimerize through the metals. X-ray crystallography of  $[\text{CpRh}(\text{CO})\text{P}(\text{OPh})_3]_2^{2+}$  confirms this rare example of a strong unsupported Rh-Rh bond (2.814  $\text{\AA}$ ). The metal-metal coupling reaction was unexpected, since dimerizations of 17-electron organometallic cations usually occur at a ligand site.

## CHEMISTRY

BITTERWOLF, Thomas E., Associate Professor, "Effect of a Series of Phosphine and Phosphite Ligands on the Taft Substituent Constants of Arenechromiumcarbonyl and Cyclopentadienylmanganese-carbonyl Complexes," *Polyhedron*, **5** (1988), 409.

A series of m- and p-fluorophenylarenechromiumcarbonyl and m- and p-fluorophenylcyclopentadienylmanganese-carbonyl complexes of phosphines and phosphites has been prepared and characterized by IR and NMR spectroscopy. Taft substituent constants were calculated from the  $^{19}\text{F}$  chemical shifts, and carbonyl stretching force constants were calculated from the carbonyl stretching frequencies of the compounds. It has been found that the phosphine and phosphite groups exert parallel effects on the Taft constants and stretching force constants and, furthermore, that the trends in the chromium and manganese series are strongly related.

CHEEK, Graham T., Associate Professor, co-author, "Electrochemical Oxidation of the 2,3-Diphenylindole System. Elucidation of the Coupling Position and Analogous Behavior for the N-Substituted System," *Journal of Organic Chemistry*, **52** (1987), 5277.

Electrochemical oxidation of 2,3-diphenylindole in acetonitrile gives a coupling product consisting of an indole ring and an indolene ring. The coupling positions between these rings have been unambiguously determined to be the 6 position on the indole ring and the 3' position on the indolene ring.

Deuterium substitution at the 6 position in 2,3-diphenylindole, with subsequent electrochemical oxidation and product characterization by mass spectrometry and deuterium NMR, enabled this clarification of the coupling pathway. An analogous coupling product was formed in the oxidation of N-methyl-2,3-diphenylindole.

CHEEK, Graham T., Associate Professor, "Electrochemistry of Hydroquinone at Ultramicroelectrodes," *Ultramicroelectrodes*, eds. B.S. Pons, M. Fleischmann, D. Rolsen, and P. Schmidt. Morganton, North Carolina: Datatech Systems, Inc., 1987, pp. 211-219.

It has been found that the amount of current observed for the oxidation of hydroquinone in methylene chloride depends markedly on the concentration of supporting electrolyte (tetra-n-butylammonium perchlorate) in the solution. This effect is apparently due to association of the hydroquinone with perchlorate ion, resulting in a decrease of the diffusion coefficient (and, therefore,

current) for hydroquinone. Infrared spectroscopy has been used to confirm this phenomenon. In acetonitrile, the effect is very small, due to the fact that hydroquinone is extensively associated with the solvent.

DUDIS, Douglas S., Assistant Professor, co-author, "Two Scandium Iodide Carbides Containing Dicarbon Units within Scandium Clusters:  $\text{Sc}_6\text{I}_{11}\text{C}_2$  and  $\text{Sc}_4\text{I}_6\text{C}_2$  Synthesis, Structure, and the Bonding of Dicarbon," *Inorganic Chemistry*, **26** (1987), 1933.

The title compounds were synthesized from  $\text{ScI}_3$ , metal, and graphite at  $850^\circ\text{C}$  in sealed niobium containers.  $\text{Sc}_6\text{I}_{11}\text{C}_2$  contains discrete  $\text{M}_6\text{X}_{12}$ -type clusters elongated along a pseudo-4 fold axis to accommodate the  $\text{C}_2$  unit ( $d(\text{C-C}) = 1.39(2) \text{ \AA}$ ). The phase  $\text{Sc}_4\text{I}_6\text{C}_2$ , which is of marginal stability, consists of infinite chains of condensed via shared metal edges by a containing a  $\text{C}_2$  unit, namely pairs of centric clusters of  $\text{D}_{2h}$  symmetry that are connected via shared metal edges by a distorted-trigonal-prismatic cluster. Extended Huckel calculations on  $\text{Sc}_6\text{I}_{11}\text{C}_2$  indicate the principal bonding arises between cluster orbitals and  $\pi(\text{c}_u)$   $\pi^*(\text{c}_g)$  and  $\sigma_s^*(\text{a}_{2u})$  orbitals of  $\text{C}_2$  with particularly strong bonding to the two metal atoms collinear with  $\text{C}_2$  via the last two listed plus  $\sigma_p(\text{a}_{1g})$  orbital, consistent with the measured magnetic susceptibility. Comparisons are made with the bonding in  $\text{Sc}(\text{Sc}_6\text{I}_{12}\text{C})$  in other centered clusters.

ELERT, Mark L., Associate Professor, co-author, "Lattice Parameters and Packing Energies for Helical Polyacetylene," *Macromolecules*, **20** (1987), 1411-1414.

There has been some experimental evidence that polyacetylene, the simplest electrically conducting polymer, may form in a helical rather than a planar conformation when prepared under certain conditions. This is surprising because the conjugation of the pi bonds in the carbon backbone of the planar system is expected to play an important part in the stability (as well as the conductivity) of polyacetylene. Theoretical calculations by several workers have demonstrated that, because of steric effects, the total energies of single chains of planar and helical polyacetylene are nearly the same. Therefore, the relative stability of the two isomers may ultimately depend on the crystal packing energies of the two types of crystals. In this paper the authors report calculations of the packing energy for helical polyacetylene in a hexagonal lattice, compare calculated optimal packing parameters to the experimental unit cell lengths, and consider the relative stability of helical and planar polyacetylene in the light of these results.

## CHEMISTRY

FERRANTE, Robert R., Assistant Professor, co-author, "ESR and Optical Spectroscopy of Matrix-Isolated Ethylnitrene," *Journal of Chemical Physics*, **87** (September 1987), 2421-2425.

The ethylnitrene radical  $\text{CH}_3\text{CH}_2\text{N}$  has been produced by the interaction of gaseous ethylazide with metastable  $\text{N}_2$  or Ar generated in a microwave discharge, and has been trapped in  $\text{N}_2$  and Ar matrices at 10 K. The UV absorption spectrum in solid nitrogen consists of a series of 11 bands beginning at 335 nm with an average vibrational spacing of  $320 \text{ cm}^{-1}$ . Intensity alterations suggest that two different vibrations are excited in the transition, probably a C-C-N bend corresponding to the observed spacing and a C-N stretch with vibrational frequency near  $640 \text{ cm}^{-1}$ . The electron spin resonance (ESR) spectrum at 8300 G indicates that ethylnitrene has a triplet ground state with zero-field splitting parameters  $D = 1.67 \text{ cm}^{-1}$  and  $E = 0.0035 \text{ cm}^{-1}$  in a nitrogen matrix. The hyperfine splittings differ slightly in the x and y lines and have average values of 16.0 G for N and 30.6 for the methylene H. The spectral features associated with ethylnitrene were not observed through direct photolysis of the parent ethylazide either during or after deposition. The data lend support to the conclusion that earlier assignments of the ESR spectrum of methylnitrene,  $\text{CH}_3\text{N}$ , are incorrect, and may provide a lower limit to  $|D|$  for that molecule in the matrix.

FERRANTE, Robert F., Assistant Professor, co-author, "ESR of the  $\text{C}_2^{17}\text{O}$ ,  $\text{SiC}^{17}\text{O}$ , and  $^{29}\text{Si}_2\text{O}$  Molecules," *Chemical Physics Letters*, **139** (September 1987), 426-430.

By reaction of carbon atoms or silicon atoms with  $^{17}\text{O}$ -enriched carbon monoxide,  $\text{C}_2^{17}\text{O}$  molecules were prepared and trapped in solid neon matrices at 4 K. Observation of the  $^{17}\text{O}$  ( $I = 5/2$ ) hyperfine splitting in their ESR spectra extend the  $^{13}\text{C}$  ( $I = 1/2$ ) and  $^{29}\text{Si}$  ( $I = 1/2$ ) data formerly found. The  $\text{SiSiO}$  ( $X \ 3\Sigma$ ) molecule is believed to have been detected for the first time. The asymmetric isomer is indicated by the hyperfine pattern observed for the  $^{29}\text{Si}$ -substituted molecule. Its zero-field splitting parameter  $|D|$  is  $1.91 \text{ cm}^{-1}$  in an argon matrix.

FERRANTE, Robert F., Assistant Professor, co-author, "Electron Spin Resonance of the  $\text{C}_6$ ,  $\text{C}_8$ , and  $\text{C}_{10}$  Molecules," *Journal of Chemical Physics*, **88** (March 1988), 3465-3474.

Electron spin resonance (ESR) signals attributed to the linear  $\text{C}_6$ ,  $\text{C}_8$ , and  $\text{C}_{10}$  molecules in their lowest  $^3\Sigma$  states, presumably their ground states, have been observed in solid Ne and Ar matrices at 4 K. There is evidence of two forms of the  $\text{C}_{10}$  molecule, perhaps indicating two slightly bent structural isomers. Laser vaporization of graphite and  $^{13}\text{C}$ -enriched graphite produced a high portion of these

larger molecules. Hyperfine interaction in the  $^{13}\text{C}_n$  molecules was small and resolved only for  $\text{C}_6$ , indicating cumulene-type bonding with the unpaired spins in  $p\pi$  orbitals, as in  $\text{C}_4$ . The zero-field splitting parameters  $|D|$  were found to be 0.363, 0.783, and  $0.190 \text{ cm}^{-1}$ , respectively, in solid neon. The increase in  $|D|$  through  $\text{C}_8$  is attributed to a corresponding variation in the spin-orbit coupling with low-lying states, principally the  $^1\Sigma_g^+$ , as the chains lengthen. Gross orbital spin populations and  $^1\Sigma_g^+ - X^3\Sigma_g^-$  energy differences were obtained from Hartree-Fock calculations in order to interpret the hfs and  $|D|$  data, respectively. Electron correlation was included via second and third order Moller-Plesset perturbation theory. The possibility of quasi-linear or nonlinear character in these chains is briefly considered. Relative concentrations of the linear and cyclic forms of these molecules in the vapor and in matrices were estimated from thermodynamics using their theoretically derived properties.

FITZGERALD, Jeffrey P., Assistant Professor, co-author, "Manganese 'Picnic Basket' Porphyrins: Cytochrome P-450 Active Site Analogues," *Bulletin of the Chemical Society of Japan*, **61** (January 1988), 47-57.

This paper describes studies of a new class of cytochrome P-450 model compounds called the "picnic basket" porphyrins. The "picnic basket" porphyrins are unsymmetrical porphyrins with one face sterically protected by a superstructure and the other unhindered. The manganese(III) porphyrins have been investigated as shape selective catalysts using oxygen atom donors in the presence of a sterically bulky imidazole. This paper presents ligand binding studies and competitive olefin epoxidation results which lead to the surprising conclusion that catalysis by the manganese "picnic-basket" porphyrins occurs exclusively on the sterically unhindered porphyrin face.

HECKENDORN, Debra K., Assistant Professor, co-author, "Studies Directed Toward the Synthesis of the Eremantholides 1. Preparation of a Ring A/B Model System via a Conjugate Addition-Acylation Protocol," *Tetrahedron Letters*, **28**, 31 (August 1987), 3551-3554.

The synthesis of a model A/B ring system similar to such a system found in the Eremantholide anti-tumor agents is described. The successful synthesis of this model ring system was completed based upon a stereoselective addition of an acyl anion equivalent to a butenolide. The product of this coupling then underwent further stereoselective elaboration. The final steps of this elaboration were acylation and deprotection which effected closure of the ring B hemiacetal. The stereochemistry of the final product was elucidated using nuclear magnetic spectroscopic studies which are described.

## CHEMISTRY

KOUBEK, Edward, Professor, U.S. Patent 4,12,951, 1987.

A method is provided of hydrogen peroxide sterilization of medical articles whereby are obtained the advantages of both vapor penetration, especially for such articles as surgical packs, and direct liquid-sterilant article contact, in which a vapor mixture comprising hydrogen peroxide is brought into contact with the article to be sterilized, the article being at a temperature below the dew point or condensation temperature of the vapor mixture, is caused thus to condense as a liquid film on the article, and is revaporized and hence removed from the so-sterilized article.

LINCK, Robert G., Associate Professor, co-author, "Hydrolysis of a Metal Coordinated Imine by a Proton-Containing Transition State," *Inorganic Chemistry*, 27 (20 April 1988), 1498-1502.

Kinetic studies of the rate of disappearance of  $\text{Fe}(\text{TIM})(\text{H}_2\text{O})_2^{2+}$  are reported. The rate law is first order in the Fe(II) complex, first order in  $\text{H}^+$ , and independent of the concentration of  $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ , with a second-order rate constant of  $0.178 \pm 0.005 \text{ M}^{-1} \text{ s}^{-1}$  at 25°C and an ionic strength of 0.5 M. Activation parameters for the reaction were determined to be  $\Delta H^\ddagger = 49.3 \pm 0.9 \text{ kJ/mol}$  and  $\Delta S^\ddagger = 94 \pm 3 \text{ J/(mol deg)}$ . The presence of CO or  $\text{CH}_3\text{CN}$  in the coordination shell of Fe(II) retards the reaction. The feature allows a determination of the equilibrium constant for the loss of  $\text{CH}_3\text{CN}$  from  $\text{Fe}(\text{TIM})(\text{CH}_3\text{CN})(\text{H}_2\text{O})^{2+}$ . The value is found to be  $(2.5 \pm 0.5) \times 10^{-3}$ . Spectral measurements indicate that  $\text{Fe}(\text{TIM})(\text{H}_2\text{O})_2^{2+}$  has the same electronic structure as the other iron-TIM complexes and hence is diamagnetic. The mechanism of the reaction is suggested to involve a displacement of the iron ion from the plane of the macrocyclic ring, promoted by a spin change, followed by hydrolysis of the free ligand.

WAITE, Boyd A., Associate Professor, "Analysis of Vesicle Immunolysis Assays: The Direct Binding Model," *Journal of Immunological Methods*, 102 (June 1987), 33-43.

Assays based on lysis of lipid vesicles have shown high sensitivity. However, little as yet is known

about the quantitative relationships among the various assay parameters, due in part to the lack of a predictive theoretical model. This paper presents the derivation of the equations that describe a simple model assay system in terms of the total fraction of vesicles with bound antibodies and the distribution of vesicles with one, two, or more antibodies bound. The equations show how the binding of antibodies to vesicles is affected by such variables as: vesicle concentration, antigen density on vesicle surfaces, antibody concentration, and antibody affinity. With the distribution functions, experiments can be designed to determine the minimum number of antibodies needed to lyse a vesicle. In addition, it is shown how estimations of the ultimate sensitivity of lipid vesicle lytic assays can be made. The model can be used to optimize vesicle lysis assay systems.

WAITE, Boyd A., Associate Professor, "Models of Immunolysis Assays: A Vesicle-based Approach for Direct Binding," *Theoretical Immunology*, ed. Alan S. Perelson. New York: Addison Wesley, 1988, pp. 103-117.

Many detailed theoretical studies of ligand/receptor binding phenomena have been presented, including kinetic studies and equilibrium studies of monovalent, bivalent, and multivalent ligands interacting with monovalent or bivalent receptors. Cross-linking effects have been modeled, as well as branching structures leading to patch formation, etc. Nearly all of these studies have focused directly on ligand/receptors are bound to be of infinite extent, thus precluding the possibility of addressing questions such as the number of bound receptors or cross-links per cell or per vesicle. The purpose of this study is to propose a receptor carrier-based approach for studying the effects of ligand/binding interactions for a variety of simple systems, all of which involve monovalent receptor sites embedded within the vesicle membranes. Such an approach ties closely with actual experimental probes, many of which involve nothing more than vesicle-counting methods. If the binding phenomenon of interest manifests itself differently for vesicles bound in distinct ways, then such a model should prove useful for interpreting and verifying certain binding mechanisms as well as effector mechanisms.

# Presentations

BITTERWOLF, Thomas E., Associate Professor, "Possible Steric Consequences in the Dimerization of Cyclopentadienyl Rhodium Cations," Gordon Research Conference on Organometallics, New London, New Hampshire, 4 August 1987.

BITTERWOLF, Thomas E., Associate Professor, "Recent Progress in the Chemistry of Dinuclear Compounds of Ruthenium and Molybdenum," (a) University of Southampton, Southampton, England, 2 February 1988; (b) Kingston Polytechnic, Kingston, England, 12 February 1988; (c) Universitat Bielefeld, Bielefeld, West Germany, 26 February 1988; (d) Universita Pisa, Pisa, Italy, 19 April 1988.

BITTERWOLF, Thomas E., Associate Professor, "Dihydrogen Evolution from Highly Basic Dinuclear Compounds of Rhodium and Iridium," (a) Universitat Wurtzburg, Wurtzburg, West Germany, 19 February 1988; (b) Universitat Bayreuth, Bayreuth, West Germany, 1 March 1988; (c) Universitat Wein, Wein, Austria, 26 April 1988; (d) Univerzity Komenskeho, Czechoslovakia, 28 April 1988; (e) Oxford University, Oxford, England, 6 May 1988.

BITTERWOLF, Thomas E., Associate Professor, "Photochemistry of Dinuclear Ruthenium Complexes-Finally a Path Through the Jungle!!," Universitat Bayreuth, West Germany, 1 March 1988.

BITTERWOLF, Thomas E., Associate Professor, "Progress in the Chemistry of Dinuclear Compounds of Ruthenium," University of Idaho, Moscow, Idaho, 20 May 1988.

BITTERWOLF, Thomas E., Associate Professor, "Use of Microscale in the Inorganic Laboratory," American Chemical Society Central Regional Meeting, Morgantown, West Virginia, 14 June 1988.

CHEEK, Graham T., Associate Professor, "Electrochemistry of Organic Compounds in Room-Temperature Molten Salts," University of Connecticut, Storrs, Connecticut, 16 December 1988.

CHEEK, Graham T., Associate Professor, "Organic Electrochemistry in Molten Salts," Poster Session at Gordon Conference on Electrochemistry, Ventura, California, 20 January 1988.

CHEEK, Graham T., Associate Professor, "Determination of Antioxidants in Lubricating Oils," Naval Air Propulsion Center, Trenton, New Jersey, April 28, 1988.

CHEEK, Graham T., Associate Professor, "Analytical Applications of Ultramicroelectrodes," 173rd Meeting of the Electrochemical Society, Atlanta, Georgia, 18 May 1988.

ELERT, Mark L., Associate Professor, "Simulation of the Onset of Detonation of Solid Energetic Materials," Energetic Materials Program, Naval Research Laboratory, Washington, DC, 25 August 1987.

ELERT, Mark L., Associate Professor, "First-Principles Results for the Geometry of *cis*-Polyacetylene," American Physical Society National Meeting, New Orleans, Louisiana, 21-25 March 1988.

ELERT, Mark L., Associate Professor, "Molecular Dynamics Simulation of the Detonation of Solid Nitric Oxide," American Physical Society National Meeting, New Orleans, Louisiana, 21-25 March 1988.

FERRANTE, Robert F., Assistant Professor, "Optical and ESR Spectroscopy of Matrix-Isolated Ethylnitrene," Forty-second Symposium on Molecular Spectroscopy, Ohio State University, Columbus, Ohio, 16 June 1987.

FITZGERALD, Jeffrey P., Assistant Professor, "Ruthenium 'Picnic-Basket' Porphyrins: Hemoprotein Active Site Analogues," Stanford University, Stanford, California, 10 June 1987.

HECKENDORN, Debra K., Assistant Professor, "Studies Directed Toward the Total Synthesis of Eremantholide A," University of Rochester, Rochester, New York, 24 November 1987.

HECKENDORN, Debra K., Assistant Professor, "A Strategy for the Synthesis of Dolabellane Diterpenes," U.S. Naval Academy Chemistry Club, Annapolis, Maryland, 13 April 1988.

LINCK, Robert G., Associate Professor, "Chemistry is Fun only from a Remote Distance," Chemistry Department Seminar, U.S. Naval Academy, Annapolis, Maryland, 4 December 1987.

LOMAX, Joseph F., Assistant Professor, "Layered Transition Metal Dichalcogenide Chemistry," Naval Research Laboratory, Washington, DC, 6 October 1987.

## CHEMISTRY

LOMAX, Joseph F., Assistant Professor, "Low Temperature Synthesis of Metal Sulfides," U.S. Naval Academy Chemistry Club, U.S. Naval Academy, Annapolis, Maryland, 17 February 1988.

MASSIE, Samuel P., Professor, "The Matter With Science: A Look at Chemistry for the Non-Major," Ninth International Conference on Chemical Education, Sao Paulo, Brazil, 25-30 July 1987.

SHADE, Joyce E., Assistant Professor, "Synthesis and Matrix Isolation Studies of Isocyanide Iron Complexes," Twentieth Central Regional Meeting of the American Chemical Society, Morgantown, West Virginia, 3 June 1988.

WAITE, Boyd A., Associate Professor, "Theoretical Modeling of Immunolysis Assays," Naval Research Laboratory Chemistry Division, Washington, DC, 19 May 1988.



DEPARTMENT OF

# Computer Science

Associate Professor Frederick A. Skove  
Chairman

This past year, research activity increased significantly in the Computer Science Department. It is believed that research promotes the reputation of the Department and the Academy, contributes to the computer science field, and makes available new concepts for computer classes. The primary areas of research include, but are not limited to: Artificial Intelligence, Software Engineering, Networks, Modeling, and Databases.

Research endeavors within the Computer Science Department are coordinated by the Department Research Committee. This committee is composed of both military and civilian faculty members. Faculty research was funded by the Naval Academy Research Council (NARC), Defense Advanced Research Project Agency (DARPA), Office of Naval Research (ONR), American Society for Engineering Education (ASEE), and Naval Research Laboratory (NRL). In addition, two military faculty are continuing to develop the AT&T grant equipment for use in a large scale integrated war gaming tactics course, establish teaching laboratories in ADA, UNIX, and distributed processing and software engineering. The Computer Science Department encourages its entire faculty to engage in research, because it is believed that both faculty and students benefit. Research will continue to hold a high priority within this department.



# Sponsored Research

## Database Management in the IDEAS Program

Researcher: Assistant Professor Nikolaos Glinos  
Sponsor: Defense Advanced Research Project Agency

This is a research project funded by a DARPA contract to Science Application International Corporation (SAIC) and the United States Naval Academy. SAIC is developing an Interactive Design, Evaluation and Analysis System (IDEAS project) for ship design. The USNA team consists of Professor Bruce Johnson (Naval Architecture), Professor Gregory White (Naval Architecture) and this researcher. The various programs to be integrated in the IDEAS system use different input data formats. This creates problems in communicating data from one program to the other. Some of the possible solutions to the above problem, which will be investigated, are the following:

(1) Use a universal data file and have the various programs of the system read this file, as well as, update it.

(2) Create a database consisting of all the input/output data utilized by the various programs of the IDEAS system. This is an attractive solution to the problem. The programs in the IDEAS systems would then have only to issue queries to the database in order to retrieve, store, and update information.

## An Expert System for Assigning Lines to Tracks

Researcher: Professor Patrick R. Harrison  
Sponsor: Naval Research Laboratory, Code 5510

This research addresses the problem of assigning acoustic sensor data or observations to tracks. The purpose is to reduce assignment errors in dense target environments and in the presence of target maneuvers. The system is being designed to imple-

ment situation driven allocation logic and rules to steer hypothesis selection for data association. The initial prototype is being implemented using the KEE development environment.

## Multiple Fault Diagnosis at a Gate Level

Researcher: Midshipman 1/C Bryan P. Graham, USN  
Adviser: Professor Patrick R. Harrison  
Sponsor: Trident Scholar Program

During the academic year 1987-1988, The midshipman researcher completed a Trident Research Project entitled, "An Expert System For Multiple Fault Diagnosis." The system can diagnose multiple faults at a gate level using model-based reasoning. It requires that a priori failure rates and models for component classes be provided. As diagnosis proceeds, it calculates and recommends the next best measurement. The findings from each

diagnosed fault are used to constrain the diagnosis of additional faults. The system has been tested on circuit boards with more than 250 components.

The system was implemented using Gold Works. This is a hybrid expert system development shell with forward and back chaining inference engines, a frame representation system, editor, and graphics interface.

# Independent Research

## The Next Best Measurement Problem in Multiple Fault Diagnosis

Researcher: Assistant Professor Nikolaos Glinos

The next best measurement problem is critical for the efficient operation of diagnostic Expert Systems. An Expert System trying to locate multiple faults performs various measurements at different test points in the system. In a system with a very large number of components, it is important to minimize

the number of required measurements or test problems required to find a fault. The researcher is investigating three approaches to the solution of this problem: minimal entropy theory, covering theory, and bayesian networks.

## Generic Multiple Fault Diagnosis (Gate)

Researcher: Professor Patrick R. Harrison

A generic, model-based, multiple fault diagnosis system is being designed and implemented using KEE. The system is capable of non-monotonic reasoning using assumption-based truth maintenance (ATMS). The researcher addresses issues having to do with representation, constraint propagation, and diagnostic efficiency. The investigation addresses also the problem of fault tolerant computing, using the MFD system to monitor, identify, and signal faults directly to a trouble-shooting system.

Corresponding research by Dr. Wayne Amsbury is investigating recent work by Pearl on belief networks as an alternative way to represent the non-monotonic reasoning problem. Using the relative worlds capability of KEE, the belief network approach will be implemented and compared to the ATMS approach to non-monotonic reasoning.

## COMPUTER SCIENCE

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### High Performance Network Simulation

Researcher: Assistant Professor Frank M. Pittelli

The world of supercomputers and parallel processors has created a need for very powerful research tools. One of the most essential tools is the network simulator. Before hardware engineers can design or build new architectures, they must have an accurate approximation of its performance characteristics. Previous simulators built in university environments have suffered from poor performance themselves. This forces researchers to use a less detailed model of the target architecture in order to run their experiments in reasonable amounts of time.

The goal of this project is to implement a flexible, high-performance network simulator for research

purposes. The simulator will be designed specifically with vector processing techniques in mind and will be implemented on a number of current supercomputers, including the CRAY-2, Convex C-1, and MultiFlow systems. Coupled with the design of the simulator is the design of an experimental parallel processor, also being developed at the Supercomputing Research Center. By designing the network simulator with a real application in mind, the researcher hopes to have a solid basis for performance measurements and enhancements.

### Modeling Complex Computer Systems

Researcher: Associate Professor Edwin T. Upchurch

The researcher is studying database applications using complex computer systems modeled on a

hyper cable. The work is being done in connection with the Jet Propulsion Laboratory at Cal Tech.



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## Publications

CHI, Frank L. K., Professor, "A New Self-Similar Space-time," *Journal of Mathematical Physics*, 28 (July 1987), 1539-1540.

A new self-similar solution of the Einstein field equations is presented. In the new space-time, the density is zero at time zero and follows an inverse square law for large  $t$ . The new solution may have interesting astrophysical applications, since it has the same reference lengths as that of the Fiedmann universe.

PITTELLI, Frank M., Assistant Professor, co-author, "Recovery in a Triple Modular Redundant Database System," *Proceedings* of Seventh International Conference on Distributed Computing Systems, Berlin, Germany, 21-25 September 1987, pp. 514-520.

In a Triple Modular Redundant (TMR) database system, the database is fully replicated at three computers. All transactions are executed at all nodes in the same relative order. The system can tolerate the arbitrary failure of a single computer, since the correct data can be obtained from the two operating copies. After a failure, it is important to repair the computer so that the system can tolerate additional future failures. Repair in this case involves getting a correct and up-to-date copy of the database, without halting the two operational nodes. In this paper the authors analyze this database recovery problem. They describe a solution that has been implemented on an experimental TMR system running on SUN-2/120 workstations. The paper also presents performance results that illustrate the cost of recovery.

SKOVE, Frederick A., Associate Professor, Jerome WILLIAMS and John W. FOERSTER, Professors, "Diurnal Variation of Surface Phytoplankton in the Patuxent River," *Estuarine Variability*, ed. D. Wolfe. New York: Academic Press, (1986), pp. 193-202.

Data were taken at two-hour intervals over a 14-hour period at a station near the mouth of the Patuxent River, a sub-estuary of the Chesapeake Bay. This station was occupied on 13-14 July 1983, and the sequence was repeated on 15-16 June 1984, with similar results. Measurements of surface beam

transmittance indicated a diurnal variation with a minimum occurring at about 1800 and a maximum after midnight. The late afternoon transmittance was about half that during nighttime. Optical measurements were correlated with concentration of suspended particles, and changes in the size distribution of the suspended material were associated with changes in transparency. Through the use of optical measurements, particle counts, chlorophyll a measurements, and phytoplankton analyses, the researchers determined that phytoplankton populations are probably changing by at least an order of magnitude over each diurnal cycle. Examination of tidal movement and the entire water column led to the conclusion that these daily variations were due to grazing, and were not associated with horizontal advection or sinking. A mathematical model using a bimodal grazing pattern, coupled with an exponential solar-controlled growth rate, fitted the data reasonably well.

UPCHURCH, Edwin T., Associate Professor, co-author, "Performance Model of Vax-Cluster," *Australian Computer Science Committee*, 10, 1 (February 1988), 101-114.

An approach to modeling complex computer systems using the non-procedural modeling language PAWS is described. The approach is illustrated by modeling a VAX-cluster in an academic environment. An approximate queuing network solution is obtained and compared with the PAWS model solution. Some related research and development work in modeling methodology and tools are briefly discussed.

## Presentations

HARRISON, Patrick R., Professor, "Evaluation of Knowledge-Based System," Second Annual Space Symposium, Annapolis, Maryland, May 1988.

PITTELLI, Frank M., Assistant Professor, "Recovery in a Triple Modular Redundant Database System," Seventh International Conference on Distributed Computing Systems, Berlin, Germany, 21-25 September 1987.

UPCHURCH, Edwin T., Associate Professor, "Performance Engineering," Institute of Electrical and Electronic Engineers (IEEE) Singapore Chapter, Singapore, 15 August 1987.

UPCHURCH, Edwin T., Associate Professor, "Expert Systems and Systems Modeling," Third Baden-Baden Conference on Systems Research, Informatics and Cybernetics, Baden-Baden, West Germany, 21 August 1987.



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# Mathematics

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Professor Frederic I. Davis  
Chairman

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The Mathematics Department has had another very productive year. Approximately forty research articles appeared this past year in refereed journals published throughout the United States and abroad. Another thirty articles have been accepted for publication and will appear shortly. The topics covered in these articles are as varied as mathematics itself. They range from the "applied" areas of partial differential equations, numerical analysis, and robotics to the "pure" areas of number theory, algebraic geometry, and topology.

Of over sixty ongoing research projects, approximately half were undertaken independently, while the other half represent sponsored research. Sponsors of the department research included the Office of Naval Research, the National Science Foundation, the Johns Hopkins Applied Physics Laboratory, the David Taylor Research Center, the Naval Academy Research Council, and the Naval Academy Instructional Development Advisory Committee.

Mathematics Department members presented their work on approximately eighty different occasions at professional mathematical meetings and colloquia in the United States and several other countries. This activity, along with publication, enhances the academic stature of the Naval Academy and promotes the professional growth and reputation of those individuals involved. Research activity by the faculty adds to teaching effectiveness and provides material for investigation by midshipmen in research courses. Several midshipmen projects are described in the section Research Course Projects.



Mathematics provides a logical framework and a language indispensable to understanding the world in which we live. The following pages summarize the contributions of members of this department to this field of study. They reveal the great scope and diversity of the subject and offer glimpses of its intellectual beauty and excitement.

## Sponsored Research

### A Random Flight Model for SSBN Detectability

Researcher: Associate Professor Peter P. Andre  
Sponsor: Johns Hopkins Applied Physics Laboratory

The detectability of U.S. nuclear ballistic missile submarines by enemy submarines in a patrol environment is an important question for U.S. strategic planners. It may not be feasible to carry out experiments to measure that detectability in the full patrol situations. Thus it is useful to be able to take the results of a test in a limited situation and to translate the results to a patrol scenario. To carry

out this translation, the researcher has constructed a model for the detection of a randomly moving SSBN by an enemy SSN searching randomly for the SSBN in a fixed region. The model uses Brownian motion as the dynamic for both boats. The probability then results from solving the heat equation in an annulus with an absorbing boundary on the inner circle and a reflecting boundary on the outer circle.

### Microcomputer Support for The Core Calculus Courses

Researchers: Associate Professor Craig K. Bailey and  
Professor Howard L. Penn  
Sponsor: Naval Academy Instructional Development Advisory Committee

This project involves the use of the computer as an aid to teaching calculus. The major objective is to increase the students' understanding of the concepts in calculus. Three commercially available programs have been site licensed. These programs are Microcalc, Calculus Pad, and Calculus Toolkit. In addition the investigators, together with Associate Professor James L. Buchanan of the Mathematics Department and Assistant Professor Frank M. Pitelli of the Computer Science Department, developed a series of programs which makes use of the Enhanced Graphics Adaptors that the midshipmen have in their computers. These programs are MPP (Midshipmen Plotting Package), Root, Integrat, and Slope. A series of homework exercises was developed for Calculus I and II using these programs. In addition, every section of SM111, Calculus I, in the fall and SM112, Calculus II, in the

spring was taught with a computer in the classroom. The assignments were not just to use the computer software but also to draw conclusions from the results. Several of the assignments made connections between different sections of material in the courses.

The project is continuing for a second year. During this year assignments will be written for Calculus III. The previously written assignments for Calculus I and II will be refined. Additional programs will be written, including one that displays level curves for functions of two variables. The current software will be reviewed for possible improvements.

The authors have submitted a proposal to the National Science Foundation under its Calculus project to continue this research.

## MATHEMATICS

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### Operator Algebras in Mathematical Physics

Researcher: Assistant Professor B. Mitchell Baker  
Sponsor: Naval Academy Research Council (ONR)

In this work the researcher investigated the ordered  $K_0$ -Theory of Approximately Finite-Dimensional  $C^*$ -algebras using the methods of classical probability theory. To each such algebra is associated a random walk on the integers, and it is shown that the asymptotics of the step-distribution determine the ordered  $K_0$ -Theory of the corresponding algebra and hence the extremal trace space. Computable necessary and sufficient conditions are obtained for the corresponding  $K_0$ -Theory to be strongly

positive, and violations of strong positivity are investigated as well. As a result, the researcher obtains a characterization of several classes of random walks (e.g., strongly unimodal walks), as well as the corresponding  $K_0$ -Theory for the associated algebras. In addition, this analysis yields a complete conjugacy invariant for certain actions of the torus on UHF  $C^*$ -algebras. Finally, some partial results are obtained for  $SO(3)$  and  $n$ -torus actions as well.

### Numerical Determination of The Moduli of Viscoelastic

Researcher: Associate Professor James L. Buchanan  
Sponsor: David Taylor Research Center, Annapolis Laboratory

The response of a viscoelastic material to vibration is characterized by two moduli, the dynamic Young's modulus and the loss modulus, both of which vary with frequency of vibration. At David Taylor Research Center a project is underway to calculate these parameters for as wide a range of materials and frequencies as possible. The calculation of the moduli is obtained by solving a system of transcendental equations numerically. Previous experiments had been hampered by difficulties in obtaining convergence to the physically relevant solution and by numerical instabilities.

Considerable strides have been made in coping with these problems. A program implementing a Newton-Raphson procedure has proved nearly one hundred percent effective in obtaining convergence to the correct solution in trial runs of the experiment. Practical error bounds based on the standard deviations of the experimental data have been obtained, and difficult cases such as low loss materials where there is a danger of misinterpretation of results have been identified. The results of this project appeared in the *Journal of the Acoustical Society of America*.

### Self-Help Tutorials in Probability and Statistics

Researcher: Professor Michael W. Chamberlain  
Sponsor: Naval Academy Instructional Development Advisory Committee

The primary goal of this IDP is to produce stand-alone computer lessons for midshipmen to use as supplements to course work in probability and statistics. The lessons cover basic notions of elementary probability theory. Each lesson is intended to emphasize a certain aspect of this

theory and to give the student a better feeling for what randomness is and how mathematics attempts to model nondeterministic phenomena. In particular, elementary simulations are used to show how well the theory predicts reality.

## MATHEMATICS

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### Aspect Graphs and Computer Visions

Researcher: Associate Professor Carol G. Crawford  
Sponsor: David Taylor Research Center, Carderock Laboratory

Three-dimensional object recognition is a major research topic in computer vision. This researcher has been recognized for having written two of the earliest papers presenting aspect graph construction as a viable and productive approach to the problem of solid object representation and recognition. Currently, experts at institutions such as The University of Wisconsin and Berkeley are directing

research projects based on these papers. This author is continuing this investigation as a cooperative research project with Dr. Kevin Bowyer, University of South Florida. Specific topics being investigated include aspect and cell equivalence in complexity reduction of aspect graphs and image sequence strategies for object recognition.

### Empirical Logic and Expert System Design

Researcher: Associate Professor Carol G. Crawford  
Sponsor: David Taylor Research Center, Carderock Laboratory

Expert systems require a knowledge base and an inference procedure to apply this knowledge. The application of traditional rule based systems to real world problems is often complicated by the fact that both the data and expertise are often uncertain. Researchers have found that problems arise in using traditional probability theory to quantify this element of uncertainty.

Empirical logic is a mathematical theory that generalizes conventional probability theory. It does so by defining a generalized sample space which

allows for the simultaneous representation of the outcomes of a set of related random experiments. A major benefit of this theory is the fact that it provides for the existence of uncertainty in an empirical investigation. This project presents empirical logic as an inference model to accommodate the problems of uncertainty in expert system design. The investigator applies results from two earlier papers on empirical logic to this design problem.

### High Frequency Sonar Response of Shells

Researcher: Professor James M. D'Archangelo  
Sponsor: David Taylor Research Center, Annapolis Laboratory

The objective in this ongoing project has been to model mathematically the underwater acoustical response of various shaped shells to high frequency sonar. One technique involves the computation of complex eigenfrequencies of impenetrable or penetrable target shells. These form a pattern which is characteristic for a given target, as far as its shape and/or composition is concerned. Mathematically, the eigenfrequencies manifest themselves as poles in the amplitudes of waves scattered from

the object. After subjecting the wavefunctions to the Neumann or Dirichlet boundary conditions, the poles appear as zeros of 6x6 determinants whose entries are combinations of special functions such as Bessel, Legendre, or prolate spheriodal functions and their derivatives (depending upon the shape of the target object). High precision computer routines were written to evaluate the special functions, the determinant, and to search for the complex roots.

## Constrained Multiple Linear Regression

Researcher: Associate Professor Gary O. Fowler  
Sponsor: David Taylor Research Center, Annapolis Laboratory

Multiple linear regression frequently is applied in settings in which the coefficients represent physical quantities that are constrained by their physical meaning. These constraints can be expressed along with the optimization portion of the multiple linear regression problem as

minimize the distance between  $Y$  and  $Xb$ ,  
and satisfy  $Cb \leq A$ ,

where  $Y$  is the vector of observations of the response variable,  $X$  is the matrix of predictor variables,  $b$  is the vector of coefficients, and  $C$  is a matrix and  $A$  is a vector describing the constraints.

If the usual least squares solution for  $b$  does not satisfy all the constraints, then the solution is the orthogonal projection of  $Y$  onto the boundary of the convex set described by the constraints. This suggests a search for the solution to the constrained problem: (1) begin with the unconstrained solution, then project that solution onto the boundaries, i.e., remove a variable; (2) examine each of those solutions for violations of the constraints and their distance from the observed response; and (3) continue, as needed. An algorithm that implements these ideas was constructed. Also constructed was an algorithm that works in the other direction. It begins with no variables and adds them one at a time, occasionally removing some that have been entered earlier.

## A Contribution to The Commutator Calculus

Researcher: Associate Professor Anthony M. Gaglione  
Sponsor: Naval Academy Research Council (ONR)

The Commutator Calculus originated with identities Philip Hall proved by means of the "collective process." Hall invented the "collective process" in a classical paper in 1933. By use of the "Magnus Algebra," the researcher has established and continues to establish generalizations of the "collective process." The researcher has obtained a class of identities related to Hall's identities, but much more

general. The investigator has also examined other techniques (Lie algebraic and homological) of the commutator calculus in an updated manner. Ultimately, these identities and techniques will be applied to the study of nilpotent products of groups to obtain results which go far beyond those in the existing literature.

## Reduction of Homogeneous Yang-Mills Fields

Researcher: Associate Professor Mark J. Gotay  
Sponsor: Naval Academy Research Council (ONR)

The structure of the reduced phase space for a homogeneous Yang-Mills field on a spatially compactified  $(n+1)$ -dimensional Minkowski space-time is studied. For the gauge groups  $SU(2)$  or  $SO(3)$  it is shown that this system is equivalent to that of  $n$  interacting particles moving in  $R^3$  with zero total angular momentum. Using theory recently developed by the researcher, various types

of reductions of this system are then considered and shown to agree. Moreover, the reduced space is explicitly realized as a semialgebraic set which carries a nondegenerate Poisson algebra. The special cases  $n = 1$  (which is completely understood) and  $n = 2$  are discussed in detail.

This work is being completed. Portions of it will be published in *Nuclear Physics B*.

## MATHEMATICS

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### The Cartan Form in The Calculus of Variations

Researcher: Associate Professor Mark J. Gotay  
Sponsor: Naval Academy Research Council (ONR)

The "Cartan form" is the basic geometric object in the classical calculus of variations. However, there are several problems with this form: (1) in general it is not uniquely defined; (2) even when it is uniquely defined, the assignment of a Cartan form to a given Lagrangian is not functorial; and (3) in practice it is usually difficult to construct Cartan forms for specific Lagrangians.

This research is meant to isolate and study the fundamental properties of Cartan forms, with an eye to understanding in a simple and global way the

above problems (and thereby to minimize their effect). The investigator's approach is based on a generalization of Griffith's formulation of the calculus of variations in terms of exterior differential systems. Preliminary indications are that this approach will yield the "best possible" results, and will substantially simplify existing theory.

This work is in progress and is being carried out jointly with Professor William Shadwick of the University of Waterloo.

### A Multisymplectic Approach to The KdV Equation

Researcher: Associate Professor Mark J. Gotay  
Sponsor: Naval Academy Research Council (ONR)

A canonical multisymplectic approach to the Korteweg-de Vries equation is presented which, when space + time decomposed, gives rise to the usual symplectic description of dynamics on the appropriate space of Cauchy data. In addition to

allowing one to treat the KdV equation covariantly, this formalism enables one to derive the Gardner symplectic structure for the KdV equation in a completely systematic way.

This research has been completed and is in press.

### Communicating Mathematics

Researchers: Associate Professor Charles C. Hanna and  
Instructor Patricia Sine (English Department)  
Sponsor: Naval Academy Instructional Development Advisory Committee

To understand mathematics, a student must understand the formal language in which mathematics is communicated. This project is intended to develop, introduce, and evaluate a graduated series of lectures and exercises to help midshipmen master this language. These materials would be available in both written and videotaped form to midshipmen for instruction and review, and to faculty in the Mathematics Department and the Writing Center as resources for in-class and extra instruction.

Students completing a mathematics course should be able not only to solve appropriate problems, but

also to explain the central concepts of the subject. Students entering upper-level mathematics courses should be able to (1) use the basic vocabulary of mathematics, (2) explain the key definitions in a subject, (3) explain proofs from texts, (4) explain arguments they have discovered, and (5) write a formal mathematical proof. These goals are not now addressed explicitly in courses in the Mathematics Department. The project will attempt to move toward these goals by preparing extra instruction and supplementary materials for faculty and midshipmen.

## Infinitesimal Modeling for Midshipmen I

Researcher: Professor Robert A. Herrmann

Sponsor: Naval Academy Instructional Development Advisory Committee

In this project a series of teaching modules is being developed and supplied to all science and engineering faculty as well as selected midshipmen. These modules will present the highly sufficient and newly discovered fixed methods that correct and rigorously yield what was previously but intuitive infinitesimal processes. These procedures are the basic methods that yield integral, differential, and analytical models that characterize much natural system behavior. This will make available to midshipmen, for the first time, one fixed set of rules that are mathematically consistent and lead directly from their intuitive laboratory experiences to the appropriate analytic expressions that mirror natural

system processes. New applicable infinitesimal modeling concepts will also be developed and reported upon.

A significant new rigorous process has been developed that infinitesimally analyzes the concept of the  $n^{\text{th}}$  order approximations and their relations to micro-effects. It has been discovered that all such  $n^{\text{th}}$  order approximations for physical behavior can be characterized by means of a chain of ideals in the set of infinitesimals. This will give a rigorous procedure to determine the level of observation that is necessary when developing analytical models that display  $n^{\text{th}}$  order micro-effects.

## Orthogonal Polynomials Associated with Reflection Groups

Researchers: Assistant Professor Michael E. Hoffman and

Assistant Professor W. Douglas Withers

Sponsor: Naval Academy Research Council (ONR)

As a starting point, the investigators considered a shape in  $R^n$  that can be folded into smaller replicas of itself. Examples of such shapes (for  $n = 2$ ) include the rectangle, equilateral triangle, and isosceles right triangle. For each such shape they sought a sequence of polynomial functions from  $R^n$  to itself that, after an appropriate change of coordinates, describe the folding of the shape into itself. The simplest case--an interval in  $R$ --gives the Chebyshev polynomials of the first kind. Since each foldable shape corresponds to a group of symmetries (an affine Weyl group), to construct polynomials for each shape, it suffices to do so for the corresponding group.

Using the well-known classification of affine Weyl groups, the researchers have constructed polynomial

functions from  $R^n$  to itself associated with any affine Weyl group acting on  $R^n$  for any dimension  $n$  variables. Using the theory of affine Weyl groups, the researchers established the orthogonality properties, recurrence relations, composition properties, arithmetic formulas, and differential equations satisfied by these polynomials.

This theory provides a natural generalization of earlier *ad hoc* constructions of multivariable orthogonal polynomials. It has connections with the theory of Lie algebras and potential applications in statistical mechanics. The researchers have written two papers that have been accepted for publication, and have recently submitted a third. They are currently investigating generalizations to reflection groups on non-Euclidean spaces.

## Group Actions and Representation Theory

Researcher: Assistant Professor Michael Hoffman  
 Sponsor: Naval Academy Research Council (OMN)

Suppose a group  $G$  acts on a topological space  $X$ . Then each element of  $G$  induces an automorphism of the cohomology algebra  $H^*(X; \mathbb{Z})$ . This gives rise to several representations of  $G$ . In particular, if we let  $V_{ev}$ ,  $V_{od}$  be the vector spaces

$$V_{ev} = \bigoplus_{i \text{ even}} H^i(X; \mathbb{C}), \quad V_{od} = \bigoplus_{i \text{ odd}} H^i(X; \mathbb{C}),$$

then we have representations  $\rho: G \rightarrow GL(V_{ev})$  and  $\sigma: G \rightarrow GL(V_{od})$ , and the virtual representation  $\rho - \sigma$  has character given by the Lefschetz number. If we put restrictions on the space  $X$  (e.g., that it be a product of spheres), or on the nature of the group action (e.g., that it be free), we may obtain strong restrictions on the representations  $\rho$  and  $\sigma$ , and therefore on the group  $G$  itself. For example, if the Euler characteristic  $\xi(X)$  is nonzero and the action is free, then  $\rho - \sigma$  is faithful and  $G$  must have order dividing  $\xi(X)$  whenever  $G$  is finite.

In his papers "Free Actions of Abelian Groups on a Cartesian Power of an Even Sphere" and "Homological Restrictions on Free Group Actions," the researcher studied the case where  $G$  acts freely on  $X$  and the rational cohomology of  $X$  is a tensor product of truncated polynomial algebras on even-

dimensional generators. (In particular,  $X$  can be a product of symmetric powers of even-dimensional spheres.) The author showed that  $G$  must be a finite 2-group in this case, and, given the dimensions and heights of the generators of  $H^*(X; \mathbb{Q})$ , gave an algebraic condition on  $G$  so that any group  $G$  satisfying this condition acts freely on a space with the same rational cohomology as  $X$ . This algebraic condition has a particularly simple form if  $G$  is abelian; for nonabelian  $G$  it is harder to understand.

The researcher plans to analyze further the case of nonabelian groups  $G$ , for which he already has some partial results (for example, any nonabelian 2-group  $G$  can be made to act on a sufficiently large product of even-dimensional spheres.) He also hopes to obtain results for actions that are not free. This would require the use of representation theory as well as the Lefschetz fixed point theorem, which has been the main tool in his previous work. The recent paper of A. Adem, "Z/pZ actions on  $(S^n)^k$ ", (Translation American Mathematical Society 300 (1987), 791-809), shows what can be accomplished in this direction by starting with a fixed group  $G$  and applying the representation theory of  $G$ .

## Non-Acoustic Detection

Researcher: Professor Harold Kaplan  
 Sponsor: David Taylor Research Center, Annapolis Laboratory

This research was heavy on computer use and statistics. Two dozen sizeable programs were written to manipulate a large database. Least-squares fit was a big part of this, so it was programmed in the TRUE BASIC language to get

the benefit of the matrix routines and the easy graphics statements.

This work was classified, so the most that can be said about the actual content is that it had something to do with non-acoustic detection.

## Quasiregular Singularities in General Relativistic Spacetime

Researcher: Assistant Professor Deborah A. Konkowski  
 Sponsor: Naval Academy Research Council (ONR)

The purpose of this project is to study general relativistic spacetimes which contain quasiregular singularities. Theorems in general relativity predict singularities on large classes of spacetimes, but the nature of these singularities is mostly unknown. If mathematical tests prove that a singularity is present in a spacetime, then it can be classified as one of three types depending on its strength: quasiregular, non-scalar curvature, and scalar curvature. In this ongoing project the researcher is studying the

mildest type, quasiregular, which has a topological nature.

Two classes of spacetimes are under investigation: (1) Colliding gravitational and electromagnetic plane wave spacetimes. Unusual particle paths point to the probable existence of quasiregular singularities; and (2) Regular and Superconducting cosmic string spacetimes. If cosmic strings are modelled as infinitely thin line sources, quasiregular singularities apparently occur.

## Helmholtz Resonators

Researcher: Associate Professor Thomas J. Mahur  
Sponsor: David Taylor Research Center, Annapolis Laboratory

Helmholtz resonators are used to reduce the noise generated by the flow of air through ducts. Analytical and numerical models for the effects of such resonators are being developed to aid in the solution of the design problem of fabricating resonators which have a specified effect on the acoustic signature of air flow through a specified duct. Such devices are used to quiet submarine ventilation systems. Models for axi-symmetric cir-

cular and three-dimensional rectangular ducts are about to be validated using experimental data from the test cell. The models employ a nonstandard implementation of the outgoing wave condition at the duct termination. The focus of current research is on a realistic implementation of the impedance boundary condition at the porous interface between the duct and the resonator.

## Some Instability Problems in Nonlinear Elasticity and Plasticity

Researcher: Associate Professor Reza Malek-Madani  
Sponsor: Naval Academy Research Council (ONR)

Several experiments have pointed out that shear band formation is possible in a number of physical situations; for example, in rolling, machining and penetration. This instability can be observed, mathematically, in the solutions of the governing partial differential equations when the gradient of the displacement becomes infinite in finite time. The main cause of shear band formation has been conjectured to be the local concentration of heat that leads to the softening of the material and, thus, leads to bands of high strain at some point in the medium. The addition of heat transfer to the balance of linear momentum gives a nonlinear system of partial differential equations whose existence and stability of solutions are the subject of this project. One of the main results of this investigation proves that when the thermal softening, i.e., the derivative of the stress with respect to the temperature, exceeds a combination of the strain hardening parameter, i.e., the deriv-

ative of the stress with respect to the strain, and the strain rate sensitivity parameter, the derivative of the stress with respect to the strain rate, then the equilibrium solution to the governing partial differential equations, representing a simple shear, is unstable. Thus, when the thermal softening dominates the other parameters one should not expect to observe a homogeneous deformation (simple shear) but the more interesting nonhomogeneous deformation (shear band). This theorem is the generalization of the work of Burns & Trucano.

The next result concerns the stability of the shear band solution itself. The researcher proves that for a system governed by constant traction and prescribed temperature on the boundary, the steady state solutions are stable for a wide range of the parameters that define the stress strain law. These steady state solutions can be calibrated to behave very much like shear bands.

## MATHEMATICS

### Developing Some Numerical Concepts for Engineering Mathematics

Researcher: Professor Peter A. McCoy  
Sponsor: Naval Academy Instructional Development Advisory Committee

The focus of this experiment was to develop the concept of the discrete Fourier transform and incorporate several of its applications to supplement the Engineering Mathematics II course in areas which treat Fourier methods classically. The purpose was to provide a basic foundation of sampling methods for data derived from periodic phenomena as they arise in a laboratory setting.

The concepts of Fourier interpolation and the discrete and inverse Fourier transforms were introduced. Concepts of discrete spectra, sampling, the sampling theorem, Nyquist rates (Shannon's theorem), and bandwidth, as well as bandlimited and timelimited signals were discussed. Further

concepts of aliasing, windowing, and quantization error were included. A "real-world" version of the sampling theorem was included, as well as the basis for computer-calculated Fourier transforms. The software package "MathCad" has been incorporated as an interface with the Division of Engineering and Weapons. The Fast Fourier Transform (FFT) and inverse FFT were presented in the context of N-th order sequences and systems of linear equations. Applications to the solution of differential equations on an interval of finite length were included. Future presentations of the FFT method will be by means of matrices.

### Kirillov Models for Distinguished Representations

Researcher: Assistant Professor Courtney Moen  
Sponsor: Naval Academy Research Council (ONR)

This project analyzes the Kirillov models for those representations of n-sheeted covering groups of  $GL(2)$  over p-adic fields which have unique Whittaker models. Such representations exist only when  $n = 2$  or  $3$ . In each case, explicit formulas for the action are determined. When  $n = 2$ , these formulas are used to give a new calculation of local

factors which is independent of the Weil representation. When  $n = 3$ , the formulas show that an analog of the Weil representation is unlikely to exist in this case. A central ingredient of the calculations is an evaluation of a generalized version of Salie's sum and its relation to p-adic Bessel functions.

### On The Brown-Peterson Homology of Finite Abelian Groups on The Brown-Peterson Homology of A Product of Projective Spaces

Researcher: Assistant Professor George Nakos  
Sponsor: Naval Academy Research Council (ONR)

The first project is an attempt to generalize the researcher's doctoral thesis results that involved the finite abelian groups  $\mathbb{Z}_{/p}^2 \times \mathbb{Z}_{/p}^2$  and  $\mathbb{Z}_{/p} \times \mathbb{Z}_{/p}^n$  to any finite abelian groups. This would be an ambitious project in algebraic topology, but the tools now available (the use of the Adams Spectral Sequence, the appropriate uses of filtered complex spectral sequences, etc.) may prove to be good enough to compute the bordism groups for all kinds of groups.

The second project is a side product of the first one. In July 1987, the author noticed that his techniques for project one could be used to reprove, clarify, and possibly extend Professor D. Davis' well known paper, "A Strong Non-immersion Theorem for Real Projective Spaces" (*Annals of Mathematics*, 1985).

## MATHEMATICS

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### Applications of Geometric Measure Theory to Problems in Field Theory

Researcher: Assistant Professor Thomas Otway  
Sponsor: Naval Academy Research Council (ONR)

An investigation of Liouville properties of generalized harmonic maps between Riemannian manifolds and of singularities in coupled gauge

fields is continuing. Methods from geometric measure theory are being applied.

### Shifts on Operator Algebras

Researcher: Associate Professor Geoffrey L. Price  
Sponsors: National Science Foundation and  
Naval Academy Research Council (ONR)

The researcher's recent work has centered on the study of Shifts on Operator Algebras. This work is an algebraic analogue of shifts on Hilbert Spaces, but the extra structure involved makes an analysis much more difficult. Using some new technical results of Jones and Powers, the researcher has managed to analyze the conjugacy classes of a certain type of Shift (of index 2) on an important class of operator algebras, the  $\text{II}_1$  factors. These are weakly closed Operator Algebras admitting a trace. Work has also begun on the problem of classifying shifts on  $C(X, B(H))$ , the  $B(H)$ -valued continuous functions on a space  $X$ , and the resear-

cher has discovered interesting generalizations of earlier work of Kadison and Ringrose on automorphisms of these algebras. In the coming months the researcher hopes to improve the results in these areas, as well as to make contributions to the related problem of analyzing  $E_\phi$ -semigroups on  $B(H)$  begun by Powers and Arveson. Another related problem involving joint work with Professor Baker, is to look at the K-theory of semi-crossed products of AF-algebras with Shift actions. This work should involve a fascinating interplay between earlier work on Shifts and the structure of Operator Algebras known as Cuntz Algebras.

### Development of A Mathematics Course in Computer Simulation

Researcher: Professor Thomas J. Sanders  
Sponsor: Naval Academy Instructional Development Advisory Committee

The purpose of this project was to develop a mathematics course in discrete simulation. During the period 15 June - 15 August 1987, a textbook was selected, a proposed syllabus was constructed, and course notes on FORTRAN and a simulation modeling language, SIMAN, were written. The textbook chosen was *Discrete-Event System Simulation* by Jerry Banks and John S. Carson II, Prentice-Hall, Inc. It was decided that each midshipman in the course should be required to purchase a copy of Microsoft FORTRAN for use on an IBM compatible personal computer, such as the Z-248.

The course was taught during the spring semester to 11 midshipmen (9 1/C and 2 2/C). There was uniform agreement from the midshipmen that they had learned a lot in this course and had enjoyed doing it. This included not only new things, such as programming in FORTRAN and the use of a spreadsheet, but also reinforcement of previous courses such as probability and statistics. From the instructor's point of view, the course was a success and well worth the time and effort. It was very rewarding to him to see 1/C midshipmen working hard and enjoying it.

## Equivariant Whitehead Torsion for Compact Lie Groups

Researcher: Assistant Professor Aaron I. Stucker  
Sponsor: Naval Academy Research Council (ONR)

A recurrent problem in mathematics is deciding when two given objects are similar--in other words the problem of classification. In topology the basic object of study is a manifold which is just a generalization of  $n$ -space where  $n$  may be  $1, 2, 3, \dots$ . Given two manifolds  $M_1$  and  $M_2$ , one wants to decide when they are similar. One can look at the group of symmetries of each and compare them. Using a manifold  $M$  and its group of symmetries, one can define an invariant, called Whitehead torsion, that reflects certain geometrical properties of  $M$ .

A geometric description of Whitehead torsion that does not consider the group of symmetries was originally given by J. H. C. Whitehead. This proved crucial in proving the celebrated s-cobordism theorem which in turn was used in classifying certain manifolds called lens spaces. A geometric description of Whitehead torsion that does account for the group of symmetries, called equivariant Whitehead torsion, has been given by Illman. The group of symmetries under consideration are compact Lie groups which includes the class of all finite groups. An algebraic approach was developed by

Rothenberg and recently extended by Dovermann and Rothenberg when the group of symmetries is finite.

The objective of this project is to develop an algebraic formulation of equivariant Whitehead torsion for compact Lie groups and to show that the algebraic construction agrees with the already existing geometric one. The author plans to make use of the machinery to define Reidemeister torsion for compact Lie group actions on manifolds. Unlike Whitehead torsion, which are elements of an abstract group, the Reidemeister invariant will be an actual real number.

An algebraic definition of equivariant Whitehead torsion for compact Lie groups has been developed by the author. Using homotopy theory and differential topology the investigator proved that his theory and Illman's geometrically defined theory give rise to the same algebraic quantities.

A paper on the theory and result mentioned above is in preparation. Work continues on using this theory to define Reidemeister torsion and other applications.

## Theoretical Distribution of Ultrasonic Echoes

Researcher: Associate Professor John C. Turner  
Sponsor: David Taylor Research Center, Annapolis Laboratory

A particle detector has been developed based on echo returns from an ultrasonic transducer. The distribution of these echoes depends on the two dimensional field intensity function. In this paper it is shown that a parabolic field yields constant echo distribution, while a Gaussian field yields an expo-

nential echo distribution. This shows that the echo distribution is quite sensitive to the field intensity. It also suggests new methodologies for detecting and analyzing these echoes. This work has been submitted to the *IEEE Transactions on Ultrasonics*.

## Modelling Particle Size from Ultrasonic Echoes

Researcher: Associate Professor John C. Turner  
Sponsor: David Taylor Research Center, Annapolis Laboratory

A particle detector has been developed based on echo returns from an ultrasonic transducer. An empirical model has been developed that predicts particle size and amount from the distribution of ultrasonic echoes. This model was developed from data obtained from a lab version of the device,

where known amounts of particles of a known size were injected into an otherwise clean system. The resulting model performs well for moderate-sized particles. This work has been submitted to the *IEEE Transactions on Ultrasonics*.

## Implementation and Applications of Level-Index Arithmetic

Researcher: Associate Professor Peter R. Turner  
Sponsor: Naval Academy Research Council (ONR)

The primary virtue of the level-index system for computer arithmetic and number representation is the elimination of overflow and underflow as a result of arithmetic operations within the computer. There are other benefits such as removing any need to scale problems in advance.

The present project forms part of the continuing work in this area through collaboration with Olves (University of Maryland), Clemshaw (University of Lancaster, United Kingdom), and Lozier (National Bureau of Standards). The principal objectives in the period of the grant are the finalization of a

paper with Clemshaw on the application of the system to the solution of polynomial equations (which will be submitted to *Computing* this summer) and the development of algorithms for the computation of the elementary functions in the level-index system. (This will be published in the *Proceedings* of the conference "Algorithms for Approximation" at which the researcher is presenting the paper.

Work will also continue on the implementation, analysis, and applications of the system in other areas.

## A Matrix Model for Linear Feedback Shift Registers

Researcher: Associate Professor William P. Wardlaw  
Sponsor: David Taylor Research Center, Annapolis Laboratory

A matrix model is used to discover some of the properties of the linear feedback shift register (LFSR) and to consider its application to secrecy systems. First, the hardware and operation of the LFSR are briefly discussed. Then a representation of the LFSR as a finite state device is used to obtain a matrix model for the LFSR. The matrix model is employed to derive a number of known results about the period of the LFSR, as well as some new results concerning subperiods.

Cryptographic applications are suggested by the randomness properties of the LFSR bitstream output, but caution is advised: The matrix model provides a concise treatment of the cryptanalysis of the simple LFSR system.

This work has been submitted as a Naval Research Laboratory report.

## Weight-Balanced Measures and The Conjugacy Problem for One-Dimensional Maps

Researcher: Assistant Professor W. Douglas Withers  
Sponsor: Office of Naval Research

The researcher proposes to apply weight-balanced measures to the study of the conjugacy problem for one-dimensional maps. One-dimensional maps provide simple and yet flexible models for the evolution of a variety of dynamical systems. Two maps are said to be conjugate if one can be converted to the other by a coordinate change. The problem of determining conjugacy of one-dimensional maps has been of great interest in recent years and much

studied using the concept of a kneading sequence. A new approach to the conjugacy problem via weight-balanced measures leads to quite explicit results on conjugacy under much weaker hypotheses than previous work. The researcher also proposes to study the relationships between weight-balanced measures and other invariant measures in the theory of dynamical systems, such as maximal entropy measures and Gibbs states.

# Independent Research

## Hypermembrane Shells

Researcher: Associate Professor James L. Buchanan

A Hypermembrane shell is a generalization of the classical notion of a membrane shell which permits greater latitude in the specification of boundary and surface stresses and displacements. Generalized analytic function theory has been found to be an effective tool in investigating membrane shells. The researcher and a co-worker are currently exploring

the use of generalized hyperanalytic function theory in studying hypermembrane shells. To date they have succeeded in establishing a Cauchy integral representation for solutions to the stress moment problem for surfaces of positive curvature and have demonstrated the solvability of the Riemann-Hilbert problem for the stress moment equation.

## Almost Proper Line Colorings and Near Chromatic Polynomials

Researcher: Associate Professor Carol G. Crawford

Graph theory is a rapidly growing area of mathematics with more and more research being focused on applications to computer science and various real-world problems. Near Chromatic Polynomials count the number of colorings of the lines of a graph so that at most one pair of lines is assigned the same color at each vertex. They are particularly useful in scheduling and network problems.

Near Chromatic Polynomials were first introduced by this researcher and Dr. Ruth Bari as an invited

address at the First China-USA International Conference on Graph Theory and Applications, Jinan, China, June 1986. This presentation generated considerable interest, and a paper on this topic was recently accepted for publication by the New York Academy of Sciences. This ongoing project continues to explore further properties and applications of Near Chromatic Polynomials.

## The Symplectization of Science

Researcher: Associate Professor Mark J. Gotay

This project consists of writing a "popular" exposition of symplectic geometry and its applications to science which is geared to a scientifically literate audience. The exposition has four components: a historical survey, a simple explanation of

symplectic geometry, and discussions of its place in mathematics, and its role in physics.

This paper is being written with Professor James Isenberg of the University of Oregon and will appear in *The Sciences*.

## MATHEMATICS

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### Fractal Behavior and Ultrasmooth Micro-Effects

Researcher: Professor Robert A. Herrmann

In the application of nonstandard analysis to the behavior of a natural system, when a characterizing mathematical entity is infinitely close to an internal nonstandard entity, then the micro-effects characterized by the nonstandard entity are conceived of as one of the basic causes for standard behavior. This research project has led to the following basic result:

**Theorem.** Let  $K \subset \mathbf{R}^n$  be compact. If  $f: *K \rightarrow *R^m$  is internal, microcontinuous and  $f[*K] \subset L^m$ , then there exists an internal mapping  $G: *R^n \rightarrow *R^m$  such that (1)  $G$  is  $*\text{-continuously } *\text{-differentiable on } *R^n$ , (2) if  $n = 1$ , then  $G$  is  $*\text{-continuously } *\text{-differentiable on } *R^n$  for any order

$k \in *N$ , (3) with respect to  $*K$ ,  $f, G| *K$  preserve nearness, (4) internal  $G| *K$  is microcontinuous and uniformly  $S$ -continuous on  $*K$ , (5)  $f, G| *K$  are infinitely close on  $*K$ , and (6) if for some standard  $g, f = *g$ , then  $g = st(G| *K)$ .

To apply this result to fractals, simply observe that if fractal behavior is characterized by a continuous function  $f$  defined on a compact  $K \subset \mathbf{R}^n$  into  $\mathbf{R}^m$ , then the function  $*f$  satisfies the hypotheses. Since  $G$  is internal then this result can be characterized by stating that some fractal behavior may be produced by the micro-effects of an ultrasmooth ultranatural process within the nonstandard physical world.

### Dichromatic Link Invariants

Researcher: Associate Professor Mark E. Kidwell

Jim Hoste of Oregon State University and the researcher have recently submitted a forty-page paper summarizing their work of the last two years. In the case of two-colored links in which one color is used only for one unknotted component, the researchers have proved the existence of an invari-

ant which is a mutual generalization of the classical two-variable Alexander polynomial and of the two-variable Jones polynomial. They have also proved that in the general case of two-colored links, no such invariant satisfying certain well-studied properties can exist.

### Rib-Stiffened Plates

Researcher: Assistant Professor Thomas J. Maher

Asymptotic techniques were used to study secondary buckling and vibration in rib-stiffened plates subject to edge thrust loading. The mathematical model is derived through a variational analysis of the potential energy functional. The stiffeners are assumed to occupy a small percentage of the total plate area; they are allowed to have an arbitrary geometry and may be either attached (lathed) or unattached. The analysis is directed towards determining the optimal location of the stiffening

material to effect the maximum reduction of the deflection or to control the frequency of the resulting vibration. Quite simple expressions for the primary bifurcation points and bifurcating states were derived. Optimization problems in this regime can be easily solved with minimal computing power.

A manuscript dealing with static deflection problems has been submitted for publication. A manuscript dealing with vibrations will soon be submitted.

### Lipschitz Continuity of Local Minimizers of A Nonconvex Functional

Researcher: Associate Professor Reza Malek-Madani

Lipschitz continuity of local minimizers of the energy functional of an isotropic compressible hyperelastic material is studied. The functional is a nonconvex function of the deformation gradient.

Using a blowup technique, it is shown that all local minimizers are Lipschitz continuous everywhere.

This research was carried out jointly with Professor Penny D. Smith of Lehigh University.

## Stability Conditions for Shearing in Plates

Researcher: Associate Professor Reza Malek-Madani

This paper is concerned with the stability of the homogeneous shear equilibrium solution of the system

$$\rho u_{tt} = [F(u_x, u_{xt}, \Theta)]_x$$

$$\Theta_t = \lambda \Theta_{xx} + f u_{xt}$$

subject to mixed boundary conditions on the temperature  $\Theta$  and constant velocity boundary

conditions. It is proved that when the thermal softening ( $f_0$ ) dominates the shear rate sensitivity ( $f_u$ ) and the elastic response

( $f_u$ ), then the homogeneous shear solution becomes unstable. This instability is believed to be the cause for the formation of "shear bands."

## Dissipative Mechanisms

Researcher: Associate Professor Reza Malek-Madani

In 1969, C. M. Dafermos proved an existence and uniqueness theorem together with asymptotic analysis for the equation of nonlinear viscoelasticity

$$\rho u = \sigma(u_x, u_{xt})_x,$$

subject to the initial conditions

$$u(x,0) = u_0(x), \quad u_1(x,0) = u_1(x),$$

and stress-free boundary conditions, under the condition that

$$\sigma_p(p,q) \leq K[\sigma_q(p,q)]^{1/2} \quad (1)$$

for some  $K$ . In this paper the researcher proves that the above assumption on the stress  $\sigma$  violates the standard assumption in continuum mechanics that

$$\sigma \rightarrow -\infty \text{ as } u_x \rightarrow 0, \quad (2)$$

i.e., it should take an infinite amount of energy to deform a finite amount of material to zero volume. The researcher gives concrete examples of

constitutive laws for which (1) and (2) are incompatible. He next introduces a generalization of the above equations to shearing motions of incompressible materials in the plane

$$\rho u_u = [\mu(\eta_1, \eta_2, \eta_3)u_x + \nu(\eta_1, \eta_2, \eta_3)u_{x1}]_x$$

$$\rho v_u = [\mu(\eta_1, \eta_2, \eta_3)v_x + \nu(\eta_1, \eta_2, \eta_3)v_{x1}]v_{xt}$$

$$\text{where } \eta_1 = u_x^2 + v_x^2, \quad \eta_2 = u_x u_{x1} + v_x v_{x1}, \quad \eta_3 = u_{x1}^2 + v_{x1}^2$$

and  $u$  represent displacements in directions perpendicular to the  $x$  direction. The dependence of the stress on the strain is obtained through the use of the classical theorems of Rivlin and Ericksen on isotropic materials. The author presents an analysis of the existence and uniqueness of this system subject to the same initial and boundary conditions considered by Dafermos. Finally he gives a detailed account of the traveling wave solutions of this system with special interest in describing the shock waves of the limiting elastic problem.

## Travelling Waves in Nonlinearly Viscoelastic Media and Shock Structure in Elastic Media

Researcher: Associate Professor Reza Malek-Madani

In this paper the qualitative analysis for the travelling waves of the equations

$$\zeta^{tt} = [\mu(\eta_1, \eta_2, \eta_3)u_x + \nu(\eta_1, \eta_2, \eta_3)u_{xt}]_x$$

$$\zeta^{tt} = [\mu(\eta_1, \eta_2, \eta_3)V_x + \nu(\eta_1, \eta_2, \eta_3)V_{xt}]_x$$

are given. Here

$$\begin{aligned} \eta_1 &= u_x^2 + v_x^2, \quad \eta_2 = u_x u_{xt} + v_x v_{xt}, \quad \eta_3 = u_{xt}^2 + v_{xt}^2 \end{aligned}$$

and  $u$  and  $v$  are the displacements of the wave in directions perpendicular to the  $x$ -direction. Using the Conley index, it is shown that a connecting orbit of a simplified stress-strain law continues to move complicated systems, thus proving that the more complicated systems have shock waves that obey the vanishing viscosity criterion.

## Dynamical Systems as Information Generators

Researcher: Assistant Professor Paul B. Massell

Certain dynamical systems researchers, (e.g., Robert Shaw, Doyne Farmer, Joseph Ford) like to view dynamical systems as information generators. Convergence of trajectories in phase space means that the system is not generating information, so that one measurement of finite accuracy allows an observer to predict the future location of the system with an accuracy as least as good as the measurement's, whereas divergence of trajectories means the system is generating information so that the longer the range of the prediction the less accurate the prediction will be on the average (e.g., weather prediction.) Thus when a system creates infor-

mation, it causes uncertainty for an observer. There are many systems where some bundles of trajectories converge (e.g., trajectories to an attractor) and where other bundles diverge (e.g., trajectories on an attractor). The two extremes are (1) constant system (complete predictability), and (2) Bernoulli (random) system (e.g., coin flipping with no predictability). The researcher has read about various ways of measuring information generation and the connection between information generation, Kolmogorov complexity, and unprovable statements in axiom systems. He hopes to incorporate these ideas into a survey course on dynamical systems.

## Singularities of Jacobi Series on $C^2$ and The Poisson Process Equation

Researcher: Professor Peter A. McCoy

A classical theorem of Gabor Szego relates the singularities of real zonal harmonic expansions with those of associated analytic functions of a single complex variable. Zeev Nehari developed the counterpart for Legendre series in the  $C$ -plane. This paper function theoretically identifies the singularities of analytic symmetric Jacobi series on  $C^2$  with those of associated analytic functions in the

$C$ -plane. One feature is that information about the singularities of solutions of Solomon Bochner's Poisson process equation flow from the expansion co-efficients. Others are that the Szego and Nehari theorems appear on characteristic subspaces. And, that this PDE, unlike those normally encountered in function theory, is hyperbolic in the real domain.

## MATHEMATICS

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### Fractals

Researcher: Professor Mark D. Meyerson

"Fractals" is a mathematical term coined by Mandelbrot for sets with certain striking properties. Usually it is taken to mean either a set of fractional, non-integer, dimension (hence the name), or a set with certain properties of self-similarity. Drawings of these sets can be strikingly beautiful. They have applications in the field of dynamical systems.

Of special interest to this researcher within the scope of this project are certain topological and geometric questions about fractals. Topological questions include: Is a given fractal set connected? simply connected? a simple closed curve? Geometric questions include: What is the (fractional) dimension? what self-similarities are there?

### Base Change for $SL(2)$

Researchers: Assistant Professors Courtney Moen and David W. Joyner

The researchers are carrying out part of a program originally envisioned by R. P. Langlands, in which automorphic forms on different groups are compared. The specific case which this project studies is that in which the groups are  $SL(2, A(F))$  and  $SL(2, A(E))$ ,  $A(F)$  and  $A(E)$  being the adele rings

for algebraic number fields  $F$  and  $E$ . The main tool used is the Selberg trace formula. The general framework for attacking problems of this kind is well understood, but the technical complications which arise, in particular those due to L-indistinguishability, are non-trivial.

### Parity of Crossing Numbers

Researcher: Assistant Professor R. Bruce Richter

The main result is characterizing those graphs that have constant parity in the number of crossings over

all drawings in the plane. This result is to appear in the *Journal of Graph Theory*.

### Parity of Planar Covers

Researcher: Assistant Professor R. Bruce Richter

The main result is proving that if a nonplanar graph

has a planar cover, then it is an even-fold covering.

### Embeddings and The Double Cover Conjecture

Researcher: Assistant Professor R. Bruce Richter

The Double Cover Conjecture asserts that every 2-edge-connected graph contains a list of cycles such that every edge is in exactly two members of the list. The researcher is trying to establish this by showing

that there is an embedding of the graph in some surface such that every face is a cycle. This has been proved for all graphs that embed in surfaces of genus at most three.

## MATHEMATICS

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### C\*-Algebras for Graphs

Researchers: Assistant Professor R. Bruce Richter and  
Assistant Professor B. Mitchell Baker

The object of the project is to better understand the \*-product by considering its effect on various group actions on graphs.

### Graphs Embedded in Surfaces

Researcher: Assistant Professor R. Bruce Richter

This project is a continuation and amalgamation of the author's left-right path work with Lins and Shank, and the work on planar graphs with Associate Professor Mark Kidwell.

### Composition of Quadratic Forms

Researcher: Associate Professor JoAnn S. Turisco

The researcher is continuing work on a detailed study of Jordan triple systems or J-structures. This study is related to the following 100-year old problem: Given three vector spaces  $X, Y, Z$  of dimensions  $p, q, n$  respectively, and a positive definite quadratic form  $q_x, q_y, q_z$  on each space, when does there exist a nonsingular bilinear map  $B: X \times Y \rightarrow Z$  with  $q_z(B(x,y)) = q_x(x)q_y(y)$ ? Ultimately, the investigator would like to answer the following question: for fixed integers  $p, q$ , what is the smallest value of  $n$  that ensures the existence of such a map? This problem has important ramifications in algebraic topology (the existence of cross sections to various line bundles) and in diverse areas

such as combinatorics and partial differential equations. Research methods involve the study of the following  $p \times n$  matrix equations:  $G_i G_j + G_j G_i = 2S_{ij} I$ , where  $S_{ij}$  is the Kronaker delta. From these equations the researcher creates a family of Jordan algebras and studies the algebraic group formed by considering isomorphisms between their isotopes. Interesting properties appear by studying the Pierce decompositions and relations among various maximal idempotents. This problem is currently receiving much attention within the mathematical community, and this approach seems fruitful and very novel at this time.

### Signal Detection as A Rank Procedure

Researcher: Associate Professor John C. Turner

The Signal Detection method of analysis proposed by O'Mahoney is shown to be a kind of ranking procedure, similar to the Kruskal-Wallis. The principal difference is that the SD method involves

very few response levels. This results in numerous ties and reduced power. This research has been accepted for publication in the *Journal of Food Technology*.

### Using Spreadsheets in Math Courses

Researcher: Associate Professor John C. Turner

Spreadsheets have had a great impact on computing, particularly microcomputing. They can be applied to the teaching of undergraduate mathematics courses. Examples are given from Differential Equations, Calculus, Numerical Analysis, and Pro-

bability. The implications of spreadsheets in introductory computing courses are discussed. This work has been accepted for publication in *Computers in Education*.

# MATHEMATICS

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## Nonstandard Bases

Researchers: Associate Professor John C. Turner and  
Associate Professor Charles C. Hanna

Common bases for number representation include 10, 2, 8, and 16. In this work, the researchers consider a number of other bases and the effect on number representations. This gives a fuller appreciation for properties of number representation that are usually taken for granted. The bases include negative numbers, irrational numbers, and fractions. Negative bases obviate the need for minus signs, but have alternating patterns in the

places. Certain irrational numbers have interesting recurrence relations among the digits. Fractions yield pairs of representations in a way different from integer bases. They also produce numbers that are not monotone in their lexicographic ordering. This work appears to be without end, but the researchers hope to submit portions for publication within the current year.

## Numerical Analysis Summer School

Researcher: Associate Professor Peter R. Turner

The researcher directed a three-week research meeting at the University of Lancaster, as well as serving as one of the principal speakers. The main purpose of the meeting was to bring together numerical analysts and a team of internationally-renowned experts for a period of intensive study and research. The researcher was solely responsible for the organization of the program and the detailed

planning of the meeting. There was an overall theme of "Parallel Processing in Numerical Analysis"; within this theme, one course of lectures on the level-index arithmetic system was presented by Clemshaw, Olver, and the author, who is currently editing the proceedings of the meeting which are to be published by Springer-Verlag.

## Diagonalization of Matrices over A Commutative Ring

Researchers: Associate Professor William P. Wardlaw and  
Assistant Professor R. Bruce Richter

This research is an outgrowth of the research for canonical forms for similar matrices over the integers. The investigators have found necessary and sufficient conditions for diagonalizing a matrix

over an integral domain, as well as weaker results for matrices over arbitrary commutative rings. The results have been documented and accepted for publication in the *American Mathematical Monthly*.

## Finding the Smallest Matrix of Period N

Researchers: Associate Professor William P. Wardlaw and  
Assistant Professor R. Bruce Richter

A nonsingular matrix  $A$  has period  $n$ , denoted  $p(A) = n$ , if  $A^n = I$  but  $A^k \neq I$  for  $0 < k < n$ . An  $s \times s$  matrix  $A$  has size  $s$ , denoted  $s(A) = s$ . The goal of this research is to find the smallest size

$$r_K(n) = \{\min s(A) : p(A) = n \text{ and } A \text{ over } K\}$$

of any matrix over the field  $K$  having period  $n$ . The researchers have evaluated  $r_K(n)$  in terms of certain structural constants  $Q_K(n)$  of the field  $K$ , and have completely determined the latter constants over all finite fields and over the fields  $Q$ ,  $R$ , and  $C$ . The results have been written up and will be submitted for publication soon.

# MATHEMATICS

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## Euler's Theorem for Polynomials

Researcher: Associate Professor William P. Wardlaw

This work exploits the similarity of arithmetical congruence and polynomial congruence to obtain the following

Let  $m \in K[x]$ , where  $K$  is a finite field, and let

$$\begin{aligned}f(m) &= |\{f \in K[x] : 0 \leq \deg(f) < \deg(m) \text{ and } (f, m) \\&= 1\}|\end{aligned}$$

Then for any  $f \in K[x]$  with  $(f, m) = 1$ ,

$$f^{\phi(m)} \in 1 \pmod{m}.$$

A number of related ideas are developed and applied to the problem of factoring polynomials over finite fields. This work has been written up and submitted to the *American Mathematical Monthly*.

## Matrices of the Form $AB - BA$

Researcher: Associate Professor William P. Wardlaw

For any upper (or lower) triangular matrix  $U$  over a ring with identity, this work gives a construction for matrices  $A$  and  $B$  satisfying  $AB - BA = U$ . Over a commutative ring with identity, this leads to necessary and sufficient conditions for expressing an upper triangular matrix  $U$  in the form  $AB - BA$ . Over a field, it is shown that a matrix  $U$  whose eigenvalues lie in the field is a commutator  $[A, B]$

$= AB - BA$  if and only if its trace  $\text{tr}(U) = 0$ . Thus, over an algebraically closed field, a matrix is a commutator if and only if its trace is zero. That is, if  $K$  is algebraically closed, every element of  $\text{sl}(n, K)$  is a commutator.

This work has been written up and will be submitted for publication soon.

## Integer Programming

Researcher: Associate Professor Carvel S. Wolfe

The purpose of the project is to solve general scheduling problems involving a circulant coefficient matrix. The difficulty of the problems increases with the number of blocks of consecutive ones in any column of the circulant matrix. The case of one block is essentially solved by linear programming. Cases for two and four blocks were considered and solved with special heuristic algorithms by researchers from the Indian Institute of Technology, Kanpur, India, in 1985. Ten example problems similar to those in the Indian paper were generated in each of ten problem types, ranging from a  $24 \times 24$  to a  $72 \times 72$  coefficient matrix. These problems, where workers are intermittently available and

requirements are cyclic in nature, have been shown to be NP-complete.

The branch and bound method with penalties could handle only a few of these problems, due to the large number of tying nodes. A cutting plane code did very well in the case of two blocks of ones per column, solving all but one of 50 problems generated.

In the case of four blocks of ones, the cutting plane code ran into convergence trouble due to degeneracy, and solved only 57% of the problems tried. In convergent cases the cutting plane code is easier and quicker than other algorithms. A convergence theory or predictor is needed.

# Research Course Projects

## Communication-Command-Control Network Model

Researcher: Midshipman 1/C Christopher Drewello, USN  
Adviser: Professor Thomas J. Sanders

This project dealt with modeling a communication-command-control network. The main point of interest was a network of 14 mobile missile launchers. The problem was to create a model that would enable a field commander to assess quickly where to locate his command station once a specific network had been established, and to determine how many links in the communication chain it would take to communicate with a specific station. A computer program was written that would enable a field commander to input his network on a grid. Once the network is drawn, the program can choose the optimal station at which to locate the command post. It can then show the shortest path to any

station the user desires. The network can then be modified to simulate the destruction of one or more of the stations and recompute the shortest path to any station. In all the networks that were input into the model, the model was able to select the command station that minimized the time necessary to communicate with all the stations, even though the location was not readily apparent to the user. This model takes all the guess-work out of locating the command station. None of the commander's time is wasted trying to locate the headquarters. The output from the model is easily understandable to anyone, even those without prior knowledge of the model.

## Symbolic Manipulation of Polynomials

Researcher: Midshipman 1/C Bruce A. Jobe, USN  
Adviser: Associate Professor Richard F. Maruszewski, Jr.

The project entailed writing a system of programs in PROLOG which would allow students to manipulate polynomials symbolically and to perform the usual operations in this manner. Included operations are the addition, multiplication, derivatives, and integrals. Also included was a parsing shell which would allow the user to input polynomials

into a PROLOG usable form. Of course, answers were returned to the users in the familiar form. The goal of the project was to acquaint the researcher with techniques of symbolic manipulation and shell writing and to implement the ideas learned in SM485, Advanced PROLOG.

## Theorem Prover

Researcher: Midshipman 1/C Bruce A. Jobe, USN  
Adviser: Associate Professor Richard F. Maruszewski, Jr.

Based on artificial intelligence techniques, the project consisted in writing a system of programs in PROLOG which would produce an indirect proof for a logic theorem. The user inputs multiple hypotheses and a conclusion to a friendly shell which then changes the input into a clausal form. Variables are allowed within the sentences so predicate calculus proofs are also given. Modus

tolens is the primary logical tool used to create new clauses until a contradiction is attained. The input and all steps are then outputted to the user as a record of the proof. The project was an adjunct to SM486, Advanced PROLOG II, and its purpose was to allow the researcher to implement the course material.

## Aegis 2000 Formation Assessment Project

Researcher: Midshipman 1/C William D. Park, USN  
Adviser: Professor W. Charles Mylander

The goal of the Aegis 2000 Formation Assessment Project is to evaluate the relative merits of four Blue (American) Battleship battle group formations in an engagement with a Red (Soviet) multi-regiment air-launched anti-ship cruise missile (ASCM) attack. Two American formations and two Soviet raid distributions were initially developed during an internship at Johns Hopkins University Applied Physics Lab (JHU/APL). As part of the JHU/APL study, a Monte Carlo Fleet simulation model called "Floats" was utilized. The Measure of Effectiveness (MOE) used in the formation assessment was the number of Soviet ASCMs (leakers) that made it through the Blue surface-to-air (SAM) missile defenses.

The technical method employed in this study was to use FLOATS to simulate the engagement and then analyze the outcome. The leaker data were compiled for each formation and subject to statistical analysis. The result of the initial analysis showed that the mean number of leakers for each formation was from a normally distributed population. In the next test, a two-factor Analysis of Variance (ANOVA) test indicated there were interactions between the formation factor and the raid factor. The Tukey method of multiple pairwise comparisons of treatment means then identified the Blue formation against a Red multi-regiment ASCM attack. This formation is a compact formation specifically designed for AAW area defense.

## Independent Models VS Dependent Models in The Measure OF Weapon Performance

Researcher: Midshipman 1/C Mark J. Retzloff, USN  
Adviser: Professor Thomas J. Sanders

The characteristics of individual weapons, under an assumption of independence, are often used to predict a weapon's performance in a multiple encounter (M-on-N). These predictions are usually obtained from a mathematical model which implicitly assumes that the encounters are independent of one another. The question has been posed as to whether this assumption of independence results in misleading values for the measure of a weapon system's performance in a M-on-N encounter. The purpose of this study is to determine if a model that does not make this assumption (i.e., a dependent model) will give estimates of the weapon system's performance that are statistically different than those of a model that does make this assumption (an independent model). The approach used in this

study was an analysis of a single weapon system in which all aspects except the two underlying assumptions were held constant.

Three general conclusions were drawn from the weapon system analysis. First, the two assumptions do provide a different measure of the weapon's performance, although whether or not this is misleading depends on the application of the results. Second, greater emphasis should be placed on making weapons more effective in killing targets in lieu of making them more effective in acquiring targets. Last, there is a need for further research concerning the effects of the underlying assumptions in the area of weapon system's performance measurement.

## MATHEMATICS

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### Proof by Analytic Tableaux Using Prolog

Researchers: Midshipmen 1/C Daniel P. Widdis and  
Bruce A. Jobe, USN  
Adviser: Professor James C. Abbott

Midshipman Daniel P. Widdis worked with Professor Abbott for approximately three years, beginning with SM259 on mathematical logic and ending with a research project in the computer language PROLOG. The final year was devoted to the study of "The Art of Prolog" by Sterling and Shapiro. This is a graduate course developed in Tel Aviv and at MIT during the years 1983-1986, and devoted to Logic Programming, The PROLOG Language, and Advanced Prolog Programming Techniques. Midshipman Widdis last semester was devoted to applying PROLOG using a computer to write programs using Analytic Tableaux.

Midshipman Bruce A. Jobe worked with Professor Abbott and Midshipman Widdis for the first 2 1/2 years on logic and PROLOG. During the last semester he undertook to write a program on Theorem Solvers and Indirect Proof, an application of Prolog to mathematical logic. He worked under the direction of Professor Maruszewski in using the computer to solve problems in abstract logic. These programs are non-arithmetical in nature and differ quite extensively from classical computer work.

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## Publications

ANDRE, Peter P., Professor, "Optimality of Radial Flight," *Mathematical and Computer Modelling*, **11** (1988), 1056-1058.

A target makes a loud noise which can be detected at a great distance and then the target becomes quiet. A potential pursuer who may have heard the noise will be assumed to head directly toward the position of the loud noise. The target will have no knowledge of the initial bearing of the pursuer. Given a constant speed strategy for the target, what path should the target take to minimize the chance that he is redetected by the pursuer after he has ceased making the noise? Let  $C_1$  be the tactic of a straight line flight from the initial source of noise. Let  $C_2$  be any other constant speed tactic taken by the target. The minimal distance between the target and the pursuer for each tactic  $C_i$  is a random variable  $X_i$  dependent on the initial heading of the target. Let  $F_X$  be the distribution function for the random variable  $X_1$ . We will prove that  $F_X(x) \geq \frac{1}{2}$

$F_X(x)$  for all  $x$ . Thus, for any distance  $x$ ,

there is a larger probability for the target to come within  $x$  miles of the pursuer if the target follows any non-radial flight strategy than if he follows a radial flight strategy. Note that the pursuer need not travel at a constant speed. Finally, we will drop the restriction of constant speed from the target.

BUCHANAN, James L., Associate Professor, "Numerical Solution for the Dynamic Moduli of a Viscoelastic Bar," *Journal of the Acoustical Society of America*, **81**, 6 (June 1987), 1775-1786.

The dynamic Young's modulus and loss factor of a viscoelastic material may be calculated as functions of frequency from data on the relative motions of the two ends of a bar of the material which is in harmonic oscillation at that frequency. Most inves-

tigators using this technique have confined their measurements to resonant frequencies, but it would be useful to find the moduli of the material at regular, narrowly spaced intervals of frequency. The characteristic equation, from which the moduli of the material are calculated, is investigated with respect to numerical solvability and stability. It is shown that this equation has infinitely many solutions. An apparently effective method of choosing the physically relevant solution is developed. It is found in the case of low loss materials that at certain frequencies solutions to the characteristic equation lie near zeros of the Jacobian, which are the solutions in the limiting case of a perfectly elastic material. Consequently, low loss viscoelastic materials will exhibit great sensitivity to errors in measurement at these frequencies. An error analysis is developed in order to estimate the magnitude of this instability. A microcomputer program written to solve these equations is applied to various simulated samples to illustrate the effects of this instability.

CRAWFORD, Carol G., Associate Professor, "Empirical Logic and Expert System Design," Technical Report for David Taylor Research Center, June 1988.

Empirical Logic is a mathematical theory that generalizes conventional probability theory. It does so by defining a generalized sample space which allows for the simultaneous representation of the outcomes of a set of related random experiments. A major benefit of this theory is the fact that it provides for the existence of uncertainty in an empirical investigation.

Expert systems require a knowledge base and an inference procedure. Uncertainty can be introduced whenever a judgmental rule is employed or if facts it uses are uncertain. This paper presents empirical logic as an inference model to accommodate the problems of uncertainty in expert system design.

## MATHEMATICS

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GAGLIONE, Anthony M., Associate Professor, co-author, "The Persistence of Universal Formulae in Free Algebras," *Bulletin of the Australian Mathematical Society*, 36 (1987), 11-17.

A. Tarski has conjectured that the non-Abelian absolutely free groups are elementarily equivalent in a language appropriate for group theory. Motivated by this conjecture, this paper investigates, using algebraic tools, some special cases of this conjecture. In particular, let  $g$  be a non-trivial variety of algebras. For each cardinal number  $a$ , let  $F_a(V)$  be the  $V$ -free algebra of rank  $a$ . Then for a fixed cardinal  $r$  one has the equivalence:  $F_r(V)$  discriminates  $V$  in the sense of Baumslag, Neumann, Neumann, and Neumann (B+3N) IFF the  $F_s(V)$  satisfy the same universal sentences for all  $s$  such that  $s \geq r$ . Moreover, this paper introduces the concept of strong discrimination in such a way that for a fixed finite cardinal  $r$  one has the following equivalence:  $F_r(V)$  strongly discriminates  $V$  IFF  $F_s(V)$  satisfy the same universal formulas for all  $s$  such that  $s > r$  whenever elements of  $F_r(V)$  are substituted for the unquantified variables.

On the surface it appears that strong discrimination is a stronger concept than (B+3N) discrimination. However, the authors have shown that for particular varieties (of groups) these concepts coincide.

GAGLIONE, Anthony M., Associate Professor, "Some Complexity Theory for Cryptography," Naval Research Laboratory Report 9024, June 1987.

This report concerns some of the elementary concepts in complexity theory. In particular, a mathematical model is developed for a finite-state machine and the Turning machine. This model has applications to public key cryptosystems, in determining which problems are P, NP, or NPC. The report was written to be as accessible to the nonspecialist as possible.

GAGLIONE, Anthony M., Associate Professor, "Information Theory and Public Key Cryptosystems," Naval Research Laboratory Report 9031, August 1987.

Shannon has defined the unicity distance of a random cipher as the point where there is no uncertainty over which key was used for enciphering. The unicity distance is given as a value  $N$  where  $N =$  cryptogram length in characters. The usual issue for classical cryptography is: given ciphertext (and possibly corresponding plaintext) under the assumption of a random cipher, is this

information sufficient on the average to determine the key? Here, if we let  $M$  denote the random variable (defined as the number of keys that will decipher a given intercepted cryptogram into a meaningful message), it turns out that  $M$  has a binomial distribution. Meyer and Matyas have expanded Shannon's approach applied to cryptosystems in general. This paper applies this method to public key cryptography. In particular, the author considers the RSA (Rivest-Shamir-Adelman) cryptosystem, which is probably the most widely-known public key system.

HASKELL, Peter E., Assistant Professor, "Index Theory of Geometric Fredholm Operators on Varieties with Isolated Singularities," *K-Theory*, 1 (1987), 457-466.

It sometimes happens that geometric elliptic operators on a noncompact Riemannian manifold are Fredholm. The smooth parts of singular varieties provide examples of complete and incomplete manifolds where this can happen. The indices of such operators often provide topological or geometric information about the singular variety. This paper shows that the operators of the title represent K homology elements and solves the index problem for these operators by exhibiting equivalent K homology cycles in topological form.

HASKELL, Peter E., Assistant Professor, co-author, "A New Proof of the K-Amenability of  $SU(1,1)$ ," *Index Theory of Elliptic Operators, Foliations, and Operator Algebras*. Eds. J. Kaminker, K.C. Millett, and C. Schochet. Providence, Rhode Island: American Mathematical Society, 1988, pp. 103-111.

The authors prove that  $SU(1,1)$  is K-amenable by explicitly constructing a Fredholm  $SU(1,1)$ -module that is homotopic to the trivial Fredholm  $SU(1,1)$ -module and for which the representations of  $SU(1,1)$  on the Hilbert spaces are weakly contained in the left regular representation of  $SU(1,1)$ .

HERRMANN, Robert A., Professor, "Nonstandard Consequence Operators," *Kobe Journal of Mathematics*, 4 (1987), 1-14.

This paper presents results relative to nonstandard logics as internal elements of collections of consequence operators defined on unstructured languages. One of the results is a technical by-pass of a portion of Gödel's first incompleteness theorem. A second major result shows that in the lattice finitary consequence operators the axiomatic are almost atomic.

## MATHEMATICS

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HOFFMAN, Michael E., Assistant Professor, "An Invariant of Finite Abelian Groups," *American Mathematical Monthly*, **94** (1987), 664-666.

In this note the author defines an integer isomorphism invariant of finite abelian groups which he calls the trace. If the finite abelian group  $G$  is an extension of  $G'$  by  $G''$ , then the trace of  $G$  is at least the sum of the traces of  $G'$  and  $G''$ . Further, the trace of  $G$  is the degree of the smallest symmetric group in which  $G$  imbeds.

HOFFMAN, Michael E., Assistant Professor, "Free Actions of Abelian Groups on a Cartesian Power of an Even Sphere," *Canadian Mathematical Bulletin*, **30** (1987), 358-362.

The author determines an algebraic condition necessary and sufficient for a group to act freely on the  $n$ th Cartesian power of an even-dimensional sphere, and gives a simple characterization of the abelian groups that satisfy this condition.

JOYNER, W. David, Assistant Professor, "Summation Operators and Explicit Formulas," *Portugaliae Mathematica*, **44** (1987), 119-130.

A general class of summation operators on  $L^2(A)$  is analyzed using the spectral theorem. As an example of number-theoretical interest, Weil's 'explicit formula' is used to reformulate the Riemann hypothesis in terms of tempered distributions.

JOYNER, W. David, Assistant Professor, "On the Metaplectic Analog of Kazhdan's 'Endoscopic' Lifting," *Israel Journal of Mathematics*, **61** (1988), 113-154.

A simple "twisted" form of the Selberg trace formula, due to Kazhdan, is used to prove a metaplectic analog of Kazhdan's lifting of grossencharakters of a cyclic extension of degree  $r$  to automorphic representations of  $GL(r)$ .

KIDWELL, Mark E., Associate Professor, "On the Degree of the Brandt-Lickorish-Millett-Ho Polynomial of a Link," *Proceedings of the American Mathematical Society*, **100**, 4 (1987), 755-767.

Let  $Q_L$  be the link polynomial defined by Brandt, Lickorish, Millett, and Ho. Let  $\deg Q_L$  be the maximum degree of a nonzero term. If  $p(L)$  is any regular link projection and  $B$  is any bridge (maximal connected component after undercrossing points are deleted), define the length of  $B$  as the number of crossings in which the overcrossing segment is a part of  $B$ .

Theorem 1. Let  $p(L)$  be a connected, regular link projection with  $N$  crossing points. Let  $K$  be the maximal length of any bridge in  $p(L)$ . Then  $\deg Q_L \leq N \cdot K$ .

Theorem 2. If  $p(L)$  is a prime, connected alternating projection with  $N > 0$  crossing points, then the coefficient of  $x^{N-1}$  is a positive number.

KIDWELL, Mark E., Associate Professor, "Trees and Euler Tours in Planar Graph and Its Relatives," *Proceedings of the American Mathematical Society*, **100**, 4 (1987), 618-630.

The author demonstrates one-to-one correspondences between the spanning trees in a planar graph, the spanning trees in its dual graph, the Euler tours in its medial graph (suitably oriented), and the arborescences rooted at any vertex in the medial graph.

LERNER, Bao Ting, Associate Professor, co-author, "Polynomial Representations of Grey-Level Images," *Proceedings of SPIE - The International Society for Optical Engineering*, **937** (April 1988), 104-116.

This paper presents a highly structured and compact representation of grey-level images. Addition and multiplication are defined for the set of all grey-level images which become commutative semigroups under these operations. Images can then be described as polynomials of two variables. Examples are given for ordered and randomized image patterns. Also studied are grey-level image magnification and image contours.

Although various algebraic approaches have been proposed for the description and generation of binary images, the author has developed a new polynomial architecture for the representation, interpretation, and manipulation of grey-scale imagery. This algebraic structure enhances feature extraction and should aid low-level scene analysis and pattern/contour description.

LERNER, Bao Ting, Associate Professor, co-author, "Polynomial Representations of Grey-Level Images for Robotic Vision," *Research and Technology - 1987 Annual Report of the Goddard Space Flight Center*, 1988, pp. 164-166.

This report describes preliminary research on the development of a comprehensive mathematical model for the representation of two-dimensional grey-level images for machine vision. Images can be expressed and manipulated as compact polynomials in two variables. Conventional image manipulation techniques typically produce values which exceed the range of the display system. The author's polynomial architecture offers a bounded solution range, as well as algebraic operations which are otherwise difficult or inefficient. Specific polynomial operators are examined and examples of image magnification are given.

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LERNER, Bao Ting, Associate Professor, "An Algebraic Approach to Grey-Scale Images Through Fuzzy Sets," *Proceedings of the North American Fuzzy Information Processing Society*, July 1988, pp. 104-108.

In this paper, dimensional grey-level images are described as fuzzy sets. Operations of addition and multiplication are defined such that the set of all grey-level images become commutative monoids under each of these operations respectively. A polynomial architecture is formed for image representation and manipulation. Contour enhancement and edge-detection polynomials operators are examined.

MALEK-MADANI, Reza, Associate Professor, "Waves in Nonlinearly Viscoelastic Media," *Contemporary Mathematics*, 60 (1987), 1-10.

This paper presents an existence and uniqueness theorem for shearing motions in incompressible nonlinearly viscoelastic media. Travelling wave solutions are constructed. The qualitative behavior of solutions depends on the constitutive equations, and the entropy conditions for the limiting hyperbolic system depend on the way the constitutive equations allow the vanishing of viscosity.

MARUSZEWSKI, Richard F. Jr., Associate Professor, and Lee PARSONS, Commander, USNR, "An Unexpected Way to an Expected Value," *AMATYC Journal*, (1987), 38-39.

This is a sort article illustrating an interesting way to present a topic in probability. Theorems on series and absolute convergence are used to arrive at an expected value.

MARUSZEWSKI, Richard F. Jr., Associate Professor, "The Trigonometric Function of Arcs," *AMATYC Journal*, (1987), 13-17.

This article is a discussion of an approach to teaching the trigonometric functions using arcs of circles rather than angles. The approach is suggested by finding the dictionary definitions of sine, secant, etc. and is clearly one used in the early development of the trigonometric functions. Students will enjoy using this approach as an alternative to the standard one given in most calculus courses.

MARUSZEWSKI, Richard F. Jr., Associate Professor, "Timing Your Favorite Stoplight," *The Mathematics and Computer Education Journal*, 21, 2 (1987), 128-132.

In this discussion of mathematical modeling, the problem of correctly setting a traffic light to opti-

mize the flow of traffic is undertaken. Techniques of calculus are used to give an initial solution, and then ways to improve the model are investigated. After two such improvements, some results quite different from those given by the original model are obtained for certain intersections. This example can be used to introduce post-calculus students to modeling and to the need to incorporate all major factors into such models.

MCCOY, Peter A., Professor, "Singularities of Jacobi Series on  $C^2$  and the Poisson Process Equation," *Journal of Mathematical Analysis and Applications*, 128, 1 (1987), 92-100.

A classical theorem of Gabor Szego relates the singularities of real zonal harmonic expansions with those of associated analytic functions of a single complex variable. Zeev Nehari developed the counterpart for Legendre series on the  $C$ -plane by generalizing Szego's theorem. This paper function theoretically identifies the singularities of analytic symmetric Jacobi series on  $C^2$  with those of analytic functions on the  $C$ -plane. One feature is that information about the singularities of solutions of Solomon Bochner's Poisson process equation flow from the expansion coefficients. Others are that the Szego and Nehari theorems appear on characteristic subspaces. And, that this PDE, unlike those normally encountered in function theory, is hyperbolic in the real domain.

OTWAY, Thomas H., Assistant Professor, "Point Singularities of Coupled Gauge Fields with Low Energy," *Communications in Mathematical Physics*, 111 (1987), 275-279.

Isolated singularities in higher-dimensional Yang-Mills-Higgs fields are considered. The singularities are removable if the energy is smaller than a dimensional constant.

OTWAY, Thomas H., Assistant Professor, "Removable Singularities in Coupled Yang-Mills-Dirac Fields," *Communications in Partial Differential Equations*, 12, 9 (1987), 1029-1070.

Necessary and sufficient conditions for removing point singularities from otherwise smooth solutions of the coupled Yang-Mills-Dirac equations in dimensions 4 and higher are given. A low-energy theorem is also proven for dimensions strictly exceeding 4.

## MATHEMATICS

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PENN, Howard L., Professor, "How the Computer Can Enhance the Teaching of Calculus," *Proceedings of IBM/ACIS University Conference Discipline Symposia*, (1987) pp. 23-28.

There are many issues that must be addressed when someone wishes to use the computer in the teaching of calculus. One of the first issues to be considered is who will produce the software. Pros and cons of software produced by the instructor, programs written by the student, and commercial software are considered. Another issue is where the software will be used. Possible locations of computers are in the classroom for demonstration purposes, in a computer lab where an entire class can have access to computers, and individual computers that students can use for doing homework. The widest possible availability of computers is recommended. The last issue is the type of usage. These include demonstration programs run in class, tutorial programs used in computer-aided learning, and programs to implement numeric methods, graphics software, and symbolic algebra software.

PENN, Howard L., Professor, "Software for the DE Classroom - The Vibrating Spring," *Mathematics and Computer Education*, 21 (1987), 155-158.

In Differential Equations, the vibrating spring is often studied as an application of second order, linear, ordinary, differential equations with constant coefficients. A program written by the author that animates the solution of the vibrating spring problem is described. The vibrating spring differential equation is of the form:

$$M*X'' + b*X' + K*X = C*\sin(w*X)$$

The program allows the user to input values for the 5 constants in the equation as well as the initial position and velocity of the spring. It then determines and displays the analytic solution to the problem. The program also shows animation of the spring vibration in the left half of the screen, while the graph of the position is traced out in the right half of the screen. Four examples were presented.

PENN, Howard L., Professor, "A Review of Differential Equations Software," *Collegiate Microcomputer*, 6 (1988), 33-42.

This paper presents a review of 21 different computer programs which can be used in the teaching of differential equations. Both commercial packages and freeware are considered. For each program the needed hardware, price, and address of the vendor or author are given. The reviews are based on hands-on experience whenever the author

was able to obtain a copy of the program. The paper includes an index by computer type as an aid to finding programs that will run on each computer configuration.

PENN, Howard L., Professor, "Differential Equations Software Reviews," *Computers and Mathematics, the Use of Computers in Undergraduate Instruction*, MAA Notes Number 9, The Mathematical Association of America, 1988, pp. 69-72.

The paper describes ten of the better programs available for the teaching of differential equations. The programs reviewed are "Phaser" by Huseyin Kocak, "MacMath" by John H. Hubbard and Beverley West, "MATT Graphical Display Package and Differential Equation Solver" by Ben Staat, Scott F. Porter and Mike Stark, "Ordinary Differential Equations" by J. L. Van Iwaarden, "Differential Equations Graphics Package" by Sheldon Gordon, "EZQ" sold by ACME Software, "Differential Equations" sold by Dynacorp, "Math 246 Programs" by C. H. Cook, Garry Helzer, and James A. Hummel, "ODE Demonstrations" by J. M. A. Danby, and "Spring and String" by Howard Lewis Penn.

PENN, Howard L., Professor, "Ties at Rotation," *The College Mathematics Journal*, 19 (1988), 230-239.

In this paper the author considers the version of pool called "rotation." In this game, the player receives 1 point for the 1 ball, 2 points for the 2 ball, etc. The number of combinations of balls that will lead to a tie is considered. The solution involves looking at the more general problem of the number of sets for balls numbered 1 to N that will lead to a total score of K. A recursion relation is derived for this number. In addition, the probability for a win, loss, or tie from various points in the game are considered for 2 players of equal ability with different probabilities of sinking the next ball.

PRICE, Geoffrey L., Associate Professor, "Shifts of Integer Index on the Hyperfinite  $H_1$  Factor," *Pacific Journal of Mathematics*, 132 (1988), 379-390.

This paper contains extensions of results obtained in earlier work by the author and others on shifts on the  $H_1$  hyperfinite factor. The hyperfinite  $H_1$  factor is an important example of a von Neuman algebra with trivial center. In this paper, the conjugacy classes of shifts of Jones' index  $n$  are considered. The conjugacy classes are completely determined for those shifts which satisfy a certain regularity property.

## MATHEMATICS

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TURNER, Peter R., Associate Professor, "Calculator Computation," *Computer Education*, 1987.

The ever-increasing use of computers and calculators within school mathematics strengthens the case for including an introduction to some of the ideas and methods of numerical computation within mathematics and computer science syllabi.

This note concentrates on a subject which, in a way, is the modern equivalent of interpolation in logarithmic or trigonometric tables. Although such interpolation techniques are still necessary for special functions such as the Bessel function, and as a basis for numerical integration or solution of differential equations, the elementary functions like log, exp, sin, and cos are available at the touch of a button. But how?

The most surprising thing perhaps is that all the elementary functions can be, and are, computed in most calculators by minor variations of exactly the same algorithm. The so-called CORDIC (Coordinate Rotation Digital Computer) algorithms were first developed by Volder for the trigonometric functions for use in solving in-flight navigation problems.

TURNER, Peter R., Associate Professor, co-author "Implementation of Level-Index Arithmetic Using Partial Table Look-up," *Proceedings of the Eighth Symposium on Computer Arithmetic*, eds. J. J. Irwin and R. Stefanelli, Washington, DC: IEEE Computer Society, pp. 144-147.

This paper is concerned with finding fast, efficient algorithms for performing level-index arithmetic. The approach used combines the advantages of parallel processing with the use of table look-up. The latter is used only for short words, and the result is a potential implementation with 11 operation times comparable with floating-point long multiplications.

WITHERS, W. Douglas, Assistant Professor, "Analysis of Invariant Measures in Dynamical Systems by Hausdorff Measure," *Pacific Journal of Mathematics*, 129, 2 (1987), 385-400.

Hausdorff measure is a preliminary concept in the definition of Hausdorff dimension, which is one concept of the degree of singularity of a finite measure. In general, Hausdorff measure does not permit as detailed an analysis of an arbitrary natural invariant measure arising from a dynamical system as Lebesgue measure permits of an absolutely continuous measure. It is shown that even for a dynamical system as simple as a modified Baker's transformation, the natural invariant measure has no representation as an indefinite integral with respect to any Hausdorff measure. However, Hausdorff

measure can be used to compare different natural invariant measures according to degree of singularity even when their Hausdorff dimensions are identical.

WITHERS, W. Douglas, Assistant Professor, "Calculating Derivatives with Respect to Parameters in Iterated Function Systems," *Physica*, 28D (1987), 206-214.

An iterated function system is a dynamical system consisting of several contracting maps with associated probabilities. Under certain general assumptions, long-term average values of physical quantities associated with an iterated function system which is dependent on an external parameter are differentiable functions of the parameter. This article presents methods for the calculation of the derivatives of average values with respect to a parameter. These algorithms yield values for these derivatives with an amount of computation proportional to the calculation of the average values themselves to the same accuracy. It is further shown how the derivatives might be calculated in the case where the probabilities vary with position and with the parameter.

WITHERS, W. Douglas, Assistant Professor, "Fundamental Theorems of Calculus for Hausdorff Measures on the Real Line," *Journal of Mathematical Analysis and Applications*, 129, 2 (1988), 581-595.

The fundamental theorems of calculus are extended to the treatment of Hausdorff measures on the real line. This includes the study of local properties of the graph of a function which is an indefinite integral with respect to Hausdorff measure, as well as description of the change in the Hausdorff or Lebesgue measure of a set under a differentiable or nondifferentiable deformation.

WITHERS, W. Douglas, Assistant Professor, "Folding Polynomials and Their Dynamics," *The American Mathematical Monthly*, 95, 5 (1988), 399-413.

The equilateral triangle, the right isosceles triangle, and the 30-60-90 triangle are special in that they can be folded into replicas of themselves. This article describes polynomial mappings, called folding polynomials, which are equivalent as dynamical systems to the mappings which stretch and fold these triangles onto themselves. The analogous polynomials in one dimension are the Chebyshev polynomials, whose special properties as dynamical systems are shared by folding polynomials. This construction can be carried out in any number of dimensions.

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## Presentations

ANDRE, Peter P., Professor, "The Optimality of Radial Flight," The Sixth International Conference on Mathematical Modelling, St. Louis, Missouri, 20 August 1987.

BAILEY, Craig K., Associate Professor, and Howard L. PENN, Professor, "Software for the Teaching of Calculus," U. S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 26 August 1987.

BAILEY, Craig K., Associate Professor, "Four Solutions to  $S'' = S$ ," Washington & Lee University Mathematics Colloquium, Lexington, Virginia, 9 February 1988.

BAILEY, Craig K., Associate Professor, and Howard L. PENN, Professor, "The Use of Computer Graphics and Numeric Techniques in the Teaching of Calculus," Conference on Revitalizing Calculus Instructions and the Mathematics Curriculum, Montclair State University, Upper Montclair, New Jersey, 18 April 1988.

BAILEY, Craig K. Associate Professor, "Teaching Calculus with an HP-28," Maryland, District of Columbia, Virginia Section of the Mathematical Association of America Regional Meeting, Emmitsburg, Maryland, 23 April 1988.

BAKER, B. Mitchell, Assistant Professor, "Time-Dependent Random Walks, AF Algebras, and Statistical Mechanics," Warwick, England, 18 July 1987.

BAKER, B. Mitchell, Assistant Professor, "Positivity of Polynomials, Random Walks, and a Problem of Poincare'," U.S. Naval Academy, Annapolis, Maryland, 18 October 1987.

BAKER, B. Mitchell, Assistant Professor, "Random Walks and the  $K_0$  - Theory of AF Algebras," Indianapolis, Indiana, 7 May 1988.

BUCHANAN, James L. , Associate Professor, and Howard L. PENN, Professor, "Software for Differential Equations," Minicourse presented at (1) Meeting of the Maryland, District of Columbia, Virginia Section of the Mathematical Association of America , Alexandria, Virginia, November 1987 and (2) Joint American Mathematical Society, Mathematical Association of America Meeting, Atlanta, Georgia, 8 January 1988.

CRAWFORD, Carol G., Associate Professor, "Aspect Graphs and Robot Vision System Design," Fourth Society for Industrial and Applied Mathematics Conference, San Francisco, California, 15 June 1988.

CRAWFORD, Carol G., Associate Professor, "Reviewing Mathematics Education Standards Proposed by the National Council of Teachers of Mathematics," Invited panel member for National Research Council, University of Maryland, College Park, Maryland, 21 April 1988.

CRAWFORD, Carol G., Associate Professor, "Almost Proper Line Colorings and Near Chromatic Polynomials," George Washington University Combinatorics Colloquium, Washington, DC, 11 March 1988.

CRAWFORD, Carol G., Associate Professor, "Empirical Logic and Expert Systems," Logistics Group, David Taylor Research Center, Bethesda, Maryland, 15 July 1987.

FOWLER, Gary O., Associate Professor, "Data Fitting When Residuals Have a Weibull Distribution," Annual Meetings of the American Statistical Association, San Francisco, California, 16 August 1987

FOWLER, Gary O., Asciote Professor, "A Review of POINT 5," U.S. Naval Academy Mathematics Department Computer Seminar, Annapolis, Maryland, 26 January 1988.

GAGLIONE, Anthony M., Associate Professor, "A Theorem In The Commutator Calculus," Singapore Group Theory Conference, Republic Of Singapore, 7 June 1987.

GAGLIONE, Anthony M., Associate Professor, "The Persistence of Universal Formulae in Free Algebras," New York Group Theory Seminar, New York City, New York, 30 October 1987.

GAGLIONE, Anthony M., Associate Professor, "Ranks of Quotients of Free Abelian-by-Nilpotent Groups," New York Group Theory Seminar, New York City, New York, 5 February 1987.

GAGLIONE, A. M., And H. V. Waldenger, "Remarks On The Collection Process," 843rd American Mathematical Society Meeting, College Park, Maryland, 23 April 1988.

## MATHEMATICS

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GAGLIONE, A. M., Associate Professor, co-author, "What Will Did Not Tell Us," 843rd American Mathematical Society Meeting, College Park, Maryland, 24 April 1988.

GOTAY, Mark J., Associate Professor, "A Multisymplectic Approach to Classical Field Theory," Conference on Symmetry Methods in Differential Equations, Logan, Utah, 17 June 1987.

GOTAY, Mark J., Associate Professor, "A Class of Non-Polarizable Symplectic Manifolds," Massachusetts Institute of Technology, Cambridge, Massachusetts, 26 October 1987.

GOTAY, Mark J., Associate Professor, "Multisymplectic Formalism in The Calculus of Variations, "The Special Year in Geometry and Control Theory, University of North Carolina, Chapel Hill, North Carolina, February 1988.

GOTAY, Mark J., Associate Professor, "Reduction of Homogeneous Yang-Mills Fields," Conference on Spacetime Symmetries, College Park, Maryland, 24 May 1988.

HANNA, Charles C., Associate Professor, "(P + 1)-Generated Modules," Special Session on Commutative Algebra and Algebraic Geometry, American Mathematical Society Meeting #837, Lincoln, Nebraska, 30 October 1987.

HASKELL, Peter E., Assistant Professor, "Functional Analysis and MacPherson's Conjecture," Penn State University Operator Algebras Seminar, State College, Pennsylvania, 10 November 1987.

HASKELL, Peter E., Assistant Professor, "Index Theory for Manifolds, Singular Spaces, and Operator Algebras," University of Colorado Mathematics Department Colloquium, Boulder, Colorado, 1 February 1988.

HASKELL, Peter E., Assistant Professor, "Index Theory for Manifolds, Singular Spaces, and Operator Algebras," Virginia Polytechnic Institute and State University Mathematics Department Seminar, Blacksburg, Virginia, 10 February 1988.

HERRMANN, Robert A., Professor, "Speculation and Cosmology Research," Essex Community College Conference, Essex Community College, Essex, Maryland, 28 May 1988.

HOFFMAN, Michael E., Assistant Professor, "A Generalization of The Fixed Property For Manifolds," University of Maryland Geometry/Topology Seminar, College Park, Maryland, 25 April 1988.

HOFFMAN, Michael E., Assistant Professor, "Free Actions and 2-Groups," Lehigh University Geometry and Topology Conference, Allentown, Pennsylvania, 28 May 1988.

JOYNER, W. David, Assistant Professor, "Multiplicity One For  $PSL(2)$ ," Seminar On Representation Theory, University of Maryland, College Park, Maryland, 5 May 1988.

KAPLAN, Harold M., Professor, "Non-Parametric Non-Asymptotic Regression," Probability and Statistics Day, The American University, Washington, DC, 14 November 1987.

KONKOWSKI, Deborah A., Assistant Professor, "The Spacetime Surrounding Superconducting Cosmic Strings," International Astronomical Society Symposium No. 130, Balatonfured, Hungary, 15-21 June 1987.

KONKOWSKI, Deborah A., Assistant Professor, "Effects of Quantum Fields Outside Cosomic Strings," International Astronomical Society Symposium No. 130, Balatonfured, Hungary, 15-21 June 1987.

KONKOWSKI, Deborah A., Assistant Professor, "The Importance of Symmetries in Spacetimes with Quasiregular Singularities," International Symposium on Spacetime Symmetries, College Park, Maryland, 24-28 May 1988.

LERNER, Bao-Ting, Associate Professor, "Polynomial Representations of Grey- Level Images," The International Society For Optical Engineering (SPIE) Technical Symposium on Optics, Electro-Optics and Sensors, Orlando, Florida, 4 April 1988.

LERNER, Bao-Ting, Associate Professor, "An Algebraic Approach to Grey-Scale Images Through Fuzzy Sets," North American Fuzzy Information Processing Society Conference, Washington, DC, 8 June 1988.

LERNER, Bao-Ting, Associate Professor, "A Fuzzy Set Approach to Grey-Scale Imagery," Rockwell International Science Center, Information Sciences Division Colloquium, Thousand Oaks, California, 7 June 1988.

MASSELL, Paul B. Assistant Professor, "A Survey Course on Dynamical Systems," Mathematical Association of America Local Chapter Meeting, Salisbury, Maryland, 12 June 1987.

MCCOY, Peter A., Professor, "Singular Manifolds of Harmonic Functions in Several Real Variables," Ninety-fourth Annual Meeting of the American Mathematical Society, Atlanta, Georgia, 6 January 1988.

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MYLANDER, W. Charles, Professor, "Operations Analysis at The U.S. Naval Academy," The Institute of Management Science/Operations Research Society of America, Washington, DC, 27 April 1988.

NAKOS, George, Assistant Professor, "The Adams Spectral Sequence of a Product of Two Real Projective Spaces," U.S. Naval Academy, Mathematics Department Colloquium, Annapolis, Maryland, 15 January 1988.

OTWAY, Thomas H., Assistant Professor, "Some Extensions of Liouville's Theorem," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 10 February 1988.

OTWAY, Thomas H., Assistant Professor, "Some Extensions of Liouville's Theorem," Mathematics Department Colloquium, University of Connecticut, Storrs, Connecticut, 2 March 1988.

OTWAY, Thomas H., Assistant Professor, "Liouville Theorem for Certain Nonstationary Maps," Special Session on Elliptic Equations and Geometry, American Mathematical Society Meeting, College Park, Maryland, 23 April 1988.

OTWAY, Thomas H., Assistant Professor, "A Liouville Theorem for Certain Nonstationary Maps," Conference on Topology and Geometry, Lehigh University, Bethlehem, Pennsylvania, 27 May 1988.

PENN, Howard L., Professor, "How The Computer Can Enhance The Teaching of Calculus," IBM/ACIS University Conference, Tools for Learning, Boston, Massachusetts, 27 June 1987.

PENN, Howard L., Professor, and Craig K. BAILEY, Associate Professor, "Software for The Teaching of Calculus," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 26 August 1987.

PENN, Howard L., Professor, and Craig K. BAILEY, Associate Professor, "Using Computer Graphics to Aid The Teaching of Calculus," U.S. Naval Academy Software Fair, Annapolis, Maryland, 9 September 1987.

PENN, Howard L., Professor, and James L. BUCHANAN, Associate Professor, "Computer Software for The Teaching of Differential Equations," Minicourse, Maryland, District Of Columbia, Virginia Section of The Mathematical Association of America Fall Meeting, Alexandria, Virginia, 13 November 1987.

PENN, Howard K., Professor, and Charles MYLANDER, Professor, "The Mathematics Department Software and Freeware Libraries," U.S. Naval Academy Mathematics Department Computer Seminar, Annapolis, Maryland, 30 November 1988.

PENN, Howard L., Professor, and James L. BUCHANAN, Associate Professor, "Computer Software for The Teaching of Differential Equations," Minicourse, Joint American Mathematical Society and Mathematical Association of American National Meeting, Atlanta, Georgia, 6-7 January 1988.

PENN, Howard L., Professor, and Craig K. BAILEY, Associate Professor, "The Use of Computer Graphics and Numeric Techniques in The Teaching of Calculus," Conference on Revitalizing Calculus Instruction and the Mathematics Curriculum, Montclair State University, Upper Montclair, New Jersey, 18 April 1988.

PENN, Howard L., Professor, "The Use of Computer Graphics and Numeric Software in The Teaching of Calculus," Maryland, District of Columbia, Virginia Section of the Mathematical Association of America Section Meeting, Emmitsburg, Maryland, 23 April 1988.

PRICE, Geoffrey L., Associate Professor, "Endomorphisms of Certain Operator Algebras," Howard University, Washington, DC, 13 May 1988.

PRICE, Geoffrey L., Associate Professor, "Endomorphisms of Certain Operator Algebras," Great Plains Operator Theory Seminar, Indianapolis, Indiana, 9 May 1988.

PRICE, Geoffrey L., Associate Professor, "Shifts on The Hyperfinite  $II_1$  Algebra," Eighth Southeastern Analysis Conference, Charlottesville, Virginia, 12 March 1988.

RICHTER, R. Bruce, Assistant Professor, and William P. WARDLAW, Associate Professor, "Diagonalization over Commutative Rings," Maryland, District of Columbia, and Virginia Section of the Mathematical Association of America Spring Meeting, Salisbury State College, Salisbury, Maryland, 13 June 1987.

RICHTER, R. Bruce, Assistant Professor, and William P. WARDLAW, Associate Professor, "Minimum Size Maximum Period Matrices," Ninety-fourth Annual Meeting of the American Mathematical Society, Atlanta, Georgia, 9 January 1988.

RICHTER, R. Bruce, Assistant Professor, and William P. WARDLAW, Associate Professor, "Finding the Smallest Matrix of Period  $n$ ," Maryland, District of Columbia, and Virginia Section of the Mathematical Association of America Spring Meeting, Mount Saint Mary's College, Emmitsburg, Maryland, 23 April 1988.

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TURISCO, JoAnn S., Associate Professor, "Composition Of Forms," Howard University, Washington, DC, 19 November 1987.

TURNER, Peter R., Associate Professor, "The Distribution of I. S. D. and Its Implications for Computer Design," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 9 June 1987 and National Bureau of Standards, Statistical Engineering Division Seminars, Gaithersburg, Maryland, 29 October 1987.

TURNER, Peter R., Associate Professor, "How Does Your Calculator Work?," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 9 November 1987.

TURNER, Peter R., Associate Professor, "Rock-Squaring Using Level-Index Arithmetic," International Congress on Industrial and Applied Mathematics, Paris, France, 30 June 1987.

TURNER, Peter R., Associate Professor, "Alternatives To Floating-Point: I. The Need," "Alternatives To Floating-Point: II. Some Candidates," "Implementation Schemes For Level-Index Arithmetic," Numerical Analysis Summer School, University of Lancaster, Lancaster, United Kingdom, 12-31 July 1987.

TURNER, Peter R., Associate Professor, "Do You Believe Your Computer? If So, Why?," U.S. Naval Academy Mathematics Department Computer Seminar, Annapolis, Maryland, 8 February 1988.

TURNER, Peter R., Associate Professor, "The Distribution of Leading Significant Digits," Pennsylvania State University Computer Science Seminars, University Park, Pennsylvania, 11 March 1988.

TURNER, Peter R., Associate Professor, "Elementary Function in Li Arithmetic," American Mathematical Society Regional Meeting, Knoxville, Tennessee, 25 March 1988.

WITHERS, W. Douglas, Assistant Professor, "Folding Polynomials," Department of Mathematics, University of Tokyo, Komaba, Japan, 10 June 1987.

WITHERS, W. Douglas, Assistant Professor, "Japanese National Defense Academy, &c.," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 9 September 1987.

WITHERS, W. Douglas, Assistant Professor, "The Potential Function of The Mandelbrot Set," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 20 January 1988.

WITHERS, W. Douglas, Assistant Professor, "Fractals Generated by Markov Processes," Department of Statistics, University of Maryland, College Park, Maryland, 7 April 1988.

WITHERS, W. Douglas, Assistant Professor, "Folding Polynomials," Mathematical Association of America Sectional Meeting, Mount Saint Mary's College, Emmitsburg, Maryland, 23 April 1988.

WITHERS, W. Douglas, Assistant Professor, "Fractals Generated by Markov Processes," Department of Mathematics and Statistics, University of Maryland Baltimore County, Baltimore, Maryland, 9 May 1988.

WOLFE, Carvel S., Associate Professor, "Integer Programming for Scheduling Problems with a Circulant Coefficient Matrix," U.S. Naval Academy Mathematics Department Colloquium, Annapolis, Maryland, 27 January 1988.

WOLFE, Carvel S., Associate Professor, "Simplex Programming," U.S. Naval Academy Science Workshops, U.S. Naval Academy, Annapolis, Maryland, 7-8 June 1988.

DEPARTMENT OF

# Oceanography

COMMANDER MICHAEL P. CAVANAUGH, USN  
CHAIRMAN

During the 1987-1988 Academic Year, civilian faculty members conducted sponsored research in a broad range of oceanographic and atmospheric areas. This research provided opportunities for the faculty to keep abreast of current work, and it served as the basis for qualified midshipmen to undertake related research projects.

Funding was secured from the Defense Mapping Agency, the Johns Hopkins University-Applied Physics Laboratory, the National Science Foundation, the Office of Naval Research, and the Commander, Naval Oceanography Command.

Specific areas of research activity within the Department included acoustics, latent heat in extratropical cyclone development, and a variety of meteorological and oceanographic phenomena studied by means of remote sensing using the Department's Digital Image Processing System.



# Sponsored Research

## An Investigation of Methods Used to Model Synoptic Scale Primary Productivity in The Ocean Using Remotely Sensed Data

Researcher: Lieutenant Eric S. Coolbaugh, USN  
Sponsor: Naval Academy Research Council (ONR)

Analytic and empirical models from recent publications were compared in order to determine if a "best approach" is emerging. Also, the feasibility of combining sea surface temperature and surface pigment image into these models was tested in order to generate an output image of primary productivity distribution.

Co-registered sea surface temperature and surface pigment images were entered in a FORTRAN program designed by using recently published

models. Output was an image of primary productivity. All images were compared with ground truth data.

The analytic model gave excellent results, while the empirical model seemed to suffer from regional dependencies. It is possible to use remotely sensed data for input to these models, but only if they are used in conjunction with ground truth data for calibration.

## Satellite Investigations of Upwelling in The Denmark Strait

Researcher: Professor John W. Foerster  
Sponsor: Defense Mapping Agency

Investigations of historical oceanographic records and recent infrared satellite scans in the area between longitude 24° west to 32° west and latitude 62° north to 66° north led to the discovery of a zone of apparent unstable water. This zone was between the 200-m and 1,000-m bathymetric contours west of Iceland in the Denmark Strait. The

infrared satellite scans have shown that upwelling conditions appear to exist during the polar summer in the area of the Denmark Strait. This upwelling is believed to be a function of the particular air-sea interaction that exists at this time of year. The result of this interaction has been the development of a 40,000 km<sup>2</sup> area of high biological productivity.

## A Possible Connection Between Atmospheric Forcing in The Bering Strait And The Beaufort Sea Undercurrent

Researcher: Visiting Professor Thomas L. Kozo  
Sponsor: Office of Naval Research

The Beaufort Sea Undercurrent (BSU) flows eastward on northern Alaska's inner continental shelf seaward of the 50 m isobath (Aagaard, 1984). This current can be modified by local wind forcing and/or momentum flux from the Chukchi Sea through Barrow Canyon (Aagaard, 1984). In turn, it has been shown that the entire current system from the Bering Strait to Barrow Canyon responds simultaneously to meteorological events (Coachman, et al., 1975). Recent analysis of sea ice motion in the Strait (Kozo et al., 1987) confirmed Stigebrandt's 1984 postulate that the downward sea level slope from the Bering toward the Chukchi was

steric in origin. This "permanent" slope which drives the mean northward transport through the Bering Strait (Overland and Roach, 1986) can be enhanced or eliminated by atmospheric forcing (Kozo and Torgerson, 1986; Aagaard, et al., 1985). In the latter case, reversed flow (to the south) occurs which effectively shuts off all northward transport. Unexplained fluctuations in the BSU unrelated to local wind systems can be linked to these Bering Strait flow reversals. This relationship of atmospheric forcing in the Strait to fluctuations in the BSU over a distance of 1000 km implies a type of tele-connection.

## Wind-Driven Current Flow Through The Bering Strait During The Summer Open-Water Season

Researcher: Visiting Professor Thomas L. Kozo  
Sponsor: Office of Naval Research

Aagaard, et al. (1985) have shown that the meridional wind and the resulting current flow through the Bering Strait are highly correlated (i.e., .81 at zero lag). Their current meter data came from two periods, November 1981-April 1982 and September 1976-March 1977. Both data sets are primarily from months with complete ice cover and/or dominant surface wind directions from the north to east quadrant with a high percentage of speeds greater than 8.5 m/s (Brower, et al., 1977). More recent summer current data in the Strait (Coachman, 1985, unpublished) are not highly correlated to the wind (i.e., less than .3 at zero lag). This area, in the summer, is characterized by omni-

directional surface wind roses with a low percentage of wind speeds above 8.5 m/s (Overland, 1981).

Kozo and Torgerson (1986) have found that a mesonet network computed geostrophic wind with a component from 40° reaching 8 m/s will reverse normal northward current flow through the Strait during open water periods. Winds from the north to east quadrants falling below this speed threshold will fail to reverse current flow and lead to poorly correlated data sets. Therefore estimates of transport in the Strait extrapolated into the summer season and based on wind direction alone are highly suspect.

## Atmospheric Science Education Program for Teachers (Grades 5-9)

Researcher: Assistant Professor David R. Smith  
Sponsor: National Science Foundation

The Atmospheric Science Education Program (ASEP) for Teachers was designed to improve the atmospheric science background for 26 Indiana teachers (grades 5-9), utilizing eight topics in atmospheric science to provide the foundation for instruction in the general science curriculum. An intensive four-week summer program was conducted at Purdue University (during July 1987) to enhance the knowledge of atmospheric science of the participating teachers. This workshop included lectures, laboratories, field trips, guest speakers, individual research projects, and educational applications seminars, with an emphasis on hands-on experiences as part of the total learning process. Given this background, the teachers would be well-prepared to return to their schools and adapt the materials and instruction for their individual school situation, with the opportunity to receive additional consultation from the ASEP staff for implementation and curricular development.

Materials developed for this program included a series of videotapes (The Active Atmosphere series) and an accompanying set of student-teacher activity booklets. These materials will be available for nationwide distribution through the Division of

Continuing Education (Purdue University) later in 1988. Teachers were also supplied with a set of weather instruments and instructions for setting up a weather station at each of their schools. Major accomplishments include: (1) four publications in refereed journals (atmospheric science and educational societies) by ASEP staff (two by this researcher); (2) sixteen presentations at state and national conferences by ASEP staff (six by this researcher); (3) one workshop on pre-college education in Atmospheric Science organized and chaired; and (4) three presentations by participating teachers at a state teachers conference on science education.

This current project was funded through 31 March 1988. A proposal for a similar project for teachers in grades 7-12 was submitted in June 1987 to begin 1 April 1988. NSF has negotiated budget with the principal investigator for funding, but final approval is still pending (awaiting signature by higher administrative officers). Assuming this proposal is funded, the researcher will continue to serve in the capacity as Senior Consultant in charge of atmospheric science content for the workshops and videotapes.

## **Sudden Die-Off of The Caribbean Sea Urchin and Coral Reef Algae During 1983: A Consequence of El Chichon?**

Researcher: Visiting Professor Alan E. Strong  
Sponsors: Office of Naval Research and Naval Oceanography Command

Stratospheric aerosols from El Chichon are being examined for a possible contribution to the massive, basin-wide die-off of Caribbean sea urchin in February 1983. Low light levels from increased optical thickness during maximum solar zeniths during January 1983 are being examined as a critical

factor. Optical thickness measurements are now available from Advanced Very High Resolution Radiometer data. In addition, Coastal Zone Color Scanner data will be examined for indications of reduced pigment concentrations during that period.

## **Conversion of Multichannel Sea Surface Temperature Offsets From El Chichon Aerosols During 1982/1983 to Optical Thickness Measurements**

Researcher: Visiting Professor Alan E. Strong  
Sponsors: Office of Naval Research and Naval Oceanography Command

Using quantitative benchmarks of mass density and optical thickness during four NASA aircraft missions at 100-day intervals covering the El Chichon episode of 1982/1983, the MCSST offsets as charted using

buoy-satellite differences can now be converted to actual charts of optical thickness. This revision will permit a more accurate assessment of insolation reduction on a global basis.

## **Global Sea Surface Temperature Trends during The 1980's Using Multichannel Sea Surface Temperature Monthly Means**

Researcher: Visiting Professor Alan E. Strong  
Sponsors: Office of Naval Research and Naval Oceanography Command

By 1988 it appears from MCSST monthly mean data that global SST between 60N and 60S has risen nearly 1 C since 1982. However, numerous ocean gridpoints (regions) have missing data at certain times due to MCSST operational difficulties or natural obscurations of the ocean. These data voids are being recovered using various techniques from reprocessing MCSST data to incorporation of conventional SST observations from other National

Oceanic and Atmospheric Administration monthly mean analyses. One period, August-December 1986, needs to be rerun. Extension of this 7-year record needs to be expanded to include 1980 and 1981--this would require that AVHRR data during those two years be reprocessed using the MCSST algorithms that are now available. 1979 has already been reprocessed.

## **El Nino and El Chichon Relationship?**

Researcher: Visiting Professor Alan E. Strong  
Sponsors: Office of Naval Research and Naval Oceanography Command

A paper is in the review process that presents evidence showing stratospheric aerosols in the tropical latitudes (20N to 20S) have resulted in equatorial

Eastern Pacific sea surface temperature increases over subsequent periods of 12 to 18 months.

## Research Course Projects

### **The Relationship of Alternating Cyclones and Anticyclones to Lead Formation in The Canadian Basin**

Researcher: Midshipman 2/C Brenda K. Berger, USN  
Adviser: Visiting Professor Thomas L. Kozo

In April 1982 a large lead formed west of the Canadian Archipelago in the Arctic Ocean. The lead was over 1800 km in length and 150 km in width at its maximum. It was observed to reach this maximum size within a period of four days and was driven by strong southeasterly winds; the strongest of these averaged 13.5 m/s on 30 April. Lead formation occurred in this instance much earlier than the normal spring-to-summer transition period when the ice pack tends to become loosely consolidated.

Several factors are involved in the lead formation. The first is that the ice canopy has a permanent fracture zone in the shallow water just west of the

Canadian Archipelago caused by tidal forces. The second is that a sequence of synoptic weather patterns occurred, resulting in 180° differences in wind stress in the lead area during the month of April. The third is that the scale and position of the two cyclones were coincident with the Beaufort Gyre, a main oceanographic circulation feature of the Canadian Basin. These three factors combined to bring about the ultimate opening of the ice pack at the fracture creating a lead which seems to be unique to this area. This type of large scale lead formation resulted in increased sea ice movement in the coastal ice zone north of Alaska, as well as in the lead area west of the Canadian Archipelago.

### **Sources, Sinks and Throughputs of Pollutants in The Severn River Watershed: A Model Approach for The Winter and Spring Seasons**

Researcher: Midshipman 1/C William S. Dickson, USN  
Adviser: Professor Douglas W. Edsall

An intensive sampling program along the Severn River and subsequent analysis of recovered samples will lead to a better understanding of the sources, sinks and throughputs of pollutants in this important Chesapeake Bay tributary. While the study has to date investigated only changes during the winter season, the researcher feels that the mechanics of

the various agricultural, manufacturing, commercial, and residential activities, coupled with the dynamics of the local meteorological and oceanographic processes, can be modeled, as this ongoing study continues. Such a model has relevance to the State of Maryland's attempts to reduce the introduction of pollutants into the Bay.

## Analysis of Submesoscale Eddies

Researcher: Midshipman 1/C David J. Rogers, USN  
Adviser: Visiting Professor Alan E. Strong

This paper is the product of a research project that began with the after-action report of Navy oceanographer, Paul Scully-Power. In it, he mentions the widespread existence of submesoscale eddies (SME), particularly in the Levantine basin of the Mediterranean Sea between Crete and Libya. His observations provided the genesis for the research of Ensign Debbie Klatt's Trident Scholar project. This work, in turn, was the basis for the first semester's research project.

That first effort was directed at the observation of SME via satellite data and imagery from the National Oceanic and Atmospheric Administration TIROS-N platform. The primary instrument pro-

viding data was the Advanced Very High Resolution Radiometer (AVHRR). This semester's work was oriented more toward the ocean environment in which these SME have been observed in the Levantine basin. Starting with the data set used last semester, products were created that illustrated the sea surface temperature (SST) and the thermal gradients in the area of study. Then, a qualitative analysis of the surface currents was combined with surface truth to infer the most probable flow of the surface and subsurface water masses. This product was used to draw conclusions on the possible origin of SME, their movements and lifetimes.

## Upwelling off The Southwest Coast of Iceland

Researcher: Midshipman 2/C Stephanie E. Schollaert, USN  
Adviser: Visiting Professor Thomas L. Kozo

The causes of a peculiar upwelling event (Foerster and Thompson, 1985) in June 1981 off the southwest coast of Iceland have been examined. Previously, the phenomenon was attributed to shelf-break upwelling. Closer observation of the wind velocity field during this time has shown that upwelling existed regardless of wind direction. With wind-generated upwelling precluded, another possible cause of the upwelling is abrupt topographic change (Kinsella et al., 1987). The area under consideration has two submarine canyons with average depths of 220 meters, approximately 50% deeper than the 150 m surrounding coastal shelf.

The canyon axis centers are located 30 km northeast of the upwelling location ( $64^{\circ}$  N,  $26^{\circ}$  W). The ocean current (Irminger) direction over the canyons is from the southeast. Thus, as depth increases in the canyon vicinity, potential vorticity must be conserved (Holton, 1972), causing a change in relative vorticity and a meander in the current. An initial anticyclonic bend in the current should result in colder oceanic bottom water approaching the coast. After the depth levels off again, the water can resume unperturbed flow. This circumstantial evidence supports the theory of upwelling due to topographic changes.

## Sea Ice Drift in a Coastal Ice Zone During the Spring to Summer Transition Period

Researcher: Midshipman 2/C Piper A. Smith, USN  
Adviser: Visiting Professor Thomas L. Kozo

Synoptic winds derived from National Weather Service surface analyses are traditionally used to predict sea ice motion in the coastal ice zone. However, mesoscale pressure network (mesonet) predictions of sea ice motion have been found to be more accurate in these areas (Lipoma, 1987). From March to the middle of July 1982, an automated satellite transmitting weather station was deployed on the sea ice north of Barter Island and drifted in the coastal ice zone between 142° W and 156° W. On 22 April 1987, a large lead opened in the Arctic pack just west of the Canadian Archipelago. This event preceded large increases in daily sea ice motion, despite minimal changes in sea ice con-

centration and wind stresses. The total buoy drift increased five fold (over April drift) to approximately 180 km in May. In June, the westward drift was 350 km, without an increase in wind speed or easterly persistence, due to a decrease in sea ice consolidation. On low wind days, specifically 13 June and 23 June, the station moved slightly eastward, possibly as a result of the Beaufort Sea undercurrent (Aagaard, 1984). Presently, the relationship among synoptic winds, mesoscale geostrophic winds, surface winds, and ice floe movement along the coastal ice zone is being examined.



## Publications

FOERSTER, John W., Professor, Editor, *Workshop on the Biology and Target Acoustics of Marine Life*. Washington, DC: American Institute of Biological Sciences, 1987.

A workshop was convened on the subject of target acoustics and the impact marine life has on its resolution. Scientists with expertise in marine mammal biology, fisheries science, and acoustics met to discuss the problems associated with animals, large and small, in the sea, and how their "noise" can be resolved in the Navy's operational environment.

Animals create a form of "static," a background clutter of sound, both received by passive hydrophone and noted as a target by active sonar. The size of a single animal or a group of animals presents problems in the identification of undersea vessels. Noise created through vocalization, movement in the water, and other behaviors can interfere with listening devices or become a false target.

In this workshop the problems and methods to solve these problems relative to acoustic target discrimination were discussed. While many specific recommendations and methods for solutions were offered, a common theme evolved. The theme was to develop better target strength information; better target signature information; better broad spectrum measurements of sound/vocalizations; better active sonar systems; better means for acquiring data and transmitting it from the sea environment; and standardized data acquisition.

FORESTER, John W., Professor, *Target Acoustics of Marine Life*. Washington, DC: Office of Naval Research, 1988.

Among categories of ocean phenomena, the sea is a vast field of variable sound. Because of these variable sounds the sorting of noise becomes tactically important to the Navy. It is because of sound variations, water density interference, and echoes from living animals that confident discrimination of a target by sonar or acoustically-guided

weapons may at times become problematic or compromised. Target discrimination becomes more important as undersea vehicles get quieter, and as their acoustic signature is obscured by the background sound naturally occurring in the sea.

In this volume the complex relationships of oceanic biological life relative to the noise generated by its activities are explored. The author presents methods for discerning sound as false targets or as background noise, as well as offering suggestions on where to go with present knowledge.

FORESTER, John W., Professor, "Shelf Break Upwelling in The Denmark Strait," Proceedings of the Eighth Port and Ocean Engineering Under Arctic Conditions Conference, 1988, pp. 227-238.

Investigations of historical oceanographic records and recent infrared satellite scans in the area between longitude 24° west to 32° west and latitude 62° north to 66° north led to the discovery of a zone of apparent unstable water. This zone was between the 200-m and 1,000-m bathymetric contours west of Iceland in the Denmark Strait. The study area continues to be very active in biological production and has provided the majority of the catch for the Icelandic whale fishery. A survey expedition investigated this area in June 1981. Calculations from the survey data revealed that water was transported to the northwest at  $2.3 \times 10^3 \text{ m}^3/\text{sec}$  with an average Ekman layer depth of 74 m. An anomaly in the vertical Sigma-t-disbtribution indicates water movement toward the surface. This physical information, results of water chemistry for ortho-phosphate, distribution of the biota and the infrared satellite scans led to the conclusion that upwelling conditions exist during the polar summer. The upwelling is believed to be a function of the particular air-sea interaction that time of year. The result of this interaction has been the development of a 40,000 km<sup>2</sup> area of high biological productivity.

## OCEANOGRAPHY

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SMITH, David R., Assistant Professor, co-author, "Atmospheric Science Education Program at Purdue University: Summer Program for Teachers (Grades 5-9)," *Bulletin of the American Meteorological Society*, 69 (June 1988), 628-635.

The Atmospheric Science Education Program (ASEP) established in 1986 at Purdue University had two components: (1) to conduct a summer program for teachers on topics in atmospheric science; and (2) to develop educational materials for teaching atmospheric science for grades five through nine.

The ASEP Summer Program for Teachers was conducted at Purdue University in July 1987 for selected Indiana teachers. Its purpose was to help teachers who teach science in grades five through nine to incorporate atmospheric-science topics into their school curricula. The teachers participated in a four-week program that included lectures, laboratory sessions, educational applications seminars, field trips, and guest speakers.

The ASEP staff also developed a series of videotapes and an accompanying set of instructional booklets for students and teachers. These materials were designed to reach a nationwide audience of students and teachers of science to incorporate atmospheric-related activities into the general science classroom. The participating teachers in the summer program provided input on the suitability (for the targeted school grades) of these materials, which will become available in late 1988.

Follow-up visitations were made by ASEP staff to the schools of the summer participants to determine the impact of the summer program and to assist the teachers with implementation of atmospheric science into their science classrooms. These visitations and other correspondence with the participating teachers have revealed that the teachers are actively adapting the educational materials and components of the summer program instruction into their science curricula, as well as conducting in-service training for other teachers in their own school districts and at state science teachers' meetings.

SMITH, David R., Assistant Professor, co-author, "Atmospheric Science: It's More than Meteorology," *The Science Teacher*, 55 (January 1988), 36-39.

Atmospheric science is far more than just forecasting the weather. The atmosphere, the thin gaseous envelope that surrounds our planet, is a complex system that affects activities in our lives every day. Acid rain, wind shear, the greenhouse effect--the words are so familiar as today's head-

lines. But do most people really understand that these are all problems of atmospheric science? Various problems in atmospheric science, including ozone depletion, increase in carbon dioxide concentration, acid precipitation, nuclear winter, severe storms, and wind shear are discussed.

SMITH, David R., Assistant Professor, Videotape Series entitled *The Active Atmosphere*: 9 videotapes (25-35 minutes each) developed for elementary, middle, and secondary schools, covering various topics in Atmospheric Science.

The series was completed this year and will be available for nationwide distribution to schools through the Division of Continuing Education, Purdue University (David R. Smith, Assistant Professor, co-director with G.H. Krockover and John T. Snow, Department of Earth and Atmospheric Science, Purdue University).

STRONG, Alan E., Visiting Professor, co-author, "TIROS-N Multi-channel Sea Surface Temperature Analyses Fields for the FGGE Period," *Proceedings of American Meteorological Society Conference*, 1-5 February 1988, pp. 431.

Satellite data from the TIROS-N AVHRR instrument were reprocessed for the FGGE period using a multichannel (dual window) sea surface temperature (SST) algorithm. Noise filters were developed to reduce noise in the  $3.7 \mu\text{m}$  window channel (channel 3), and separate retrieval algorithms were used for the daytime (solar zenith angle  $< 75$  degrees) and the nighttime (solar zenith angle  $> 75$  degrees) measurements. Following the initial data reduction, a monthly mean SST analysis was obtained by grouping the data into 2.5 degree latitude by 2.5 degree longitude grids for each month of 1979. Monthly mean difference fields of satellite SST vs. climatology, multichannel SST vs. GOSSTCOMP SST, and the standard deviation of the multichannel measurements within each grid were examined. In addition, month-to-month changes in satellite and climatological SST, as well as daytime vs. nighttime retrievals, were also studied.

One of the most notable improvements of the multichannel fields is more accurate and defined coverage in high gradient areas such as the Gulf Stream, Somali current, Falkland current, and Kuro Shio current. In the western Atlantic, multichannel SST comparisons to climatology are much more realistic than the GOSSTCOMP vs. climatology.

## Presentations

COOLBAUGH, Eric J., Lieutenant, USN, "An Investigation of Methods Used to Model Synoptic Scale Primary Productivity in the Ocean Using Remotely Sensed Data," American Geophysical Union/American Society for Limnology and Oceanography Ocean Sciences Meeting, New Orleans, Louisiana, 19 January 1988.

FORESTER, John W., Professor, "Shelf Break Upwelling in The Denmark Strait," Ports and Oceans under Arctic Conditions (POAC) VIII, University of Alaska, Fairbanks, Alaska, 18 August 1987.

KOZO, Thomas L., Visiting Professor, "A Possible Connection Between Atmospheric Forcing in The Bering Strait and The Beaufort Sea Undercurrent," American Geophysical Union Meeting, San Francisco, California, 9 December 1987.

KOZO, Thomas L., Visiting Professor, "Wind-driven Current Flow Through The Bering Strait During the Summer Open-water Season," American Geophysical Union-Ocean Sciences Meeting, New Orleans, Louisiana, 23 January 1988.

SMITH, David R., Assistant Professor, "Atmospheric Science Education Program," Summer Workshop for Teachers at Purdue University, Annual Meeting of the American Meteorological Society Board on School and Popular Meteorological and Oceanographic Education, Anaheim, California, 1-2 February 1988.

SMITH, David R., Assistant Professor, "1988 Update on The Active Atmosphere Videotape Series," Annual Meeting of the American Meteorological Society Board on School and Popular Meteorological and Oceanographic Education, Anaheim, California, 1-2 February 1988.

SMITH, David R., Assistant Professor, "The Active Atmosphere: A Program in Atmospheric Science (Grades 5-9)," Annual Meeting of the American Association for the Advancement of Science, Boston, Massachusetts, 14 February 1988.

SMITH, David R., Assistant Professor, "An Atmospheric Science Education Program for Middle Schools," National Association for Science Teachers, St. Louis, Missouri, 8 April 1988.

SMITH, David R., Assistant Professor, "Applying Study of Atmospheric Science into the Elementary School Classroom," Fourth Conference on Elementary Science of the Maryland Association of Science Teachers, Annapolis, Maryland, 14 May 1988.

STRONG, Alan E., Visiting Professor, and Deborah KLATT, Ensign, USN, "Submesoscale Eddies Examined Using Space Shuttle Photographs, AVHRR, and Landsat Digital Imagery," Ocean Sciences Conference - American Geophysical Union, New Orleans, Louisiana, 23 January 1988.

WILLIAMS, Jerome, Professor, "Elementary Chesapeake Bay Dynamics," Fourth Conference on Elementary Science of the Maryland Association of Science Teachers, Annapolis, Maryland, 14 May 1988.

DEPARTMENT OF

# Physics

Professor Graham D. Gutsche  
Chairman

A strong research endeavor continued unabated in the Physics Department for the past year, characterized by both breadth and vitality. The breadth is seen in the range of research areas included: non-linear acoustics, acoustics signatures of ships, submarine magnetics, galactic astronomy, atomic physics, nuclear physics, condensed matter and polymer physics, optics, and laser physics. The last area was enhanced this past year with the addition of a new civilian faculty member with a laser physics specialty. The research undertaken by the faculty was about an even mix of basic and applied research. A great deal of unfunded research and development work on computer interfacing and software development has accompanied all of these projects and as part of our laboratory development. The vitality of the program is evidenced by its productivity, resulting in fifteen published papers in research journals and twenty presentations at professional meetings. The 1987-1988 U.S. Naval Academy Research Award was presented to Professor John J. Fontanella and Associate Professor Mary C. Wintersgill, collaborators in the Department's most significant in-house research program.

Midshipmen involvement has always been a keynote of the Physics Department. For the academic year 1987-1988 the Department supported two Trident Scholars and seven midshipmen research projects.

Funding for physics research has come from department funds, Naval Academy Research Council grants, the Office of Naval Research, the Naval Research Laboratory, and the David Taylor Research Center.



# Sponsored Research

## Multispectral Observations of FIRSSE Sources

Researcher: Associate Professor C. Elise Albert  
Sponsor: Naval Research Laboratory Code 4138

The purpose of this project is to identify and study objects detected by the U.S. Air Force Geophysics Laboratory/Naval Research Laboratory for Infrared Sky Survey Experiment, which scanned 21% of the sky in four infrared bands between 17 and 120 microns. Radio observations have been made of these sources with the Very Large Array of the National Radio Astronomy Observatory, and maps have been constructed at wavelengths of both 20 cm and 6 cm. An initial study analyzed 8 of these sources which are coincident with small optical ionized hydrogen regions (*The Astrophysical Journal*

92, 75 (1986)). Work completed during academic year 1987-1988 involved analysis of Infrared Astronomical Satellite data on the structures and fluxes of 8 additional sources which are not coincident with optical H II regions. Analysis of temperatures and luminosities is expected to continue during 1988-1989.

In addition, a long term project is planned to compare the galactic distribution of interstellar emission from neutral hydrogen (at radio wavelengths), carbon monoxide (at microwave wavelengths), and dust (at infrared wavelengths).

## D.S.C. and ELectrical Conductivity Studies in PPO and PDMS-EO Containing Sodium Salts

Researcher: Lieutenant David A. Beam, USN  
Sponsor: Naval Academy Research Council (ONR)

Poly(propylene oxide) (PPO) and poly(dimethylsiloxane-ethylene-oxide) (PDMS-EO) have been studied extensively in the past few years. The primary reason is that it is easy to prepare amorphous PPO and PDMS-EO salt complexes with relatively high electrical conductivity, and thus the results are free of the complications due to crystallinity such as exist for poly(ethylene oxide), for example. One of the important issues in polymer electrolyte science involves an understanding of ion-ion interactions which are expected to be substantial in view of the high salt concen-

trations in these materials. One feature of these materials which is yielding a great deal of information concerning ion-ion interactions is that at high temperatures sodium and potassium salts tend to precipitate out of the polymer in a dramatic fashion 1-4. Previous work on PP08NaI<sup>3</sup> focused on the particular manner in which the salt precipitation (SP) resulted in anomalies in differential scanning calorimetry (DSC), <sup>23</sup>Na nuclear magnetic resonance (NMR), and electrical conductivity measurements at higher temperatures.

## Response of Multiple Coupled Dynamic Systems

Researcher: Professor Donald W. Brill  
Sponsor: David Taylor Research Center, Annapolis Laboratory

A study was made of the article, "Response of Multiple Coupled Dynamic Systems," by L. J. Maga and G. Maidanik (*Journal of Sound & Vibration*, June 1983). This method was then applied to an

acoustic cancellation coating system to see if an externally driven active piezoelectric film could be used to remove a passing sound wave. Work still remains to be done on this problem.

## Transient Response in Stimulated Raman Scattering

Researcher: Professor Gerald P. Calame  
Sponsor: Naval Research Laboratory, Code 6S40

A set of programs, written in order to study the transient response of a Raman Scattering medium to a train of pump and Stokes pulses passing through it has been extensively modified in order to study the effects of noise on the pulse trains. Noise in both the photon signal and in the initial phonon

population can be accommodated. Preliminary calculations indicate that photon noise will be very difficult to suppress at high gains, but initial phonon noise can be surpassed, after an initial transient, by alternating the sign of the pump beam in successive pulses.

## ION Beam Mixing of Molybdenum in Aluminum

Researcher: Associate Professor Francis D. Correll  
Sponsor: Naval Research Laboratory, Code 4671

This work was part of a continuing search for practical ways to improve the corrosion resistance of aluminum metal. In ion beam mixing (IBM), an energetic beam of ions is used to mix intimately together several elements in the near surface region of material. The potential of IBM for producing tough, thick, corrosion-resistant surface alloys of Mo and Al on Al metal was evaluated in this project.

The general approach was to make several different types of layered Mo/Al samples, mix them with Xe ions and use Rutherford Backscattering Spectroscopy to detect changes of the Mo/Al interface. Two kinds of samples were used: one with a vacuum-deposited layer of Mo on the surface of bulk Al, and the other with a sub-surface layer of Mo produced by ion implantation into bulk Al. Mixing was done at room temperature with Xe ions

of two different energies and doses from  $1 \times 10^{15}$  to  $4 \times 10^{17}$  ions/cm<sup>2</sup>.

Mixing with 1.8-MeV Xe produced a nearly uniform damage profile at the Mo/Al interface, and caused mixing in both kinds of samples (but with different results for the different kinds). Mixing the evaporated samples produced a smoothly-graded interface that was well fit by an error function (diffusion-like) concentration profile. The amount of mixing was found to increase almost linearly with the dose of mixing ions after a threshold dose of about  $1 \times 10^{16}$  ions/cm<sup>2</sup>. By contrast, mixing the implanted samples produced several distinct Mo/Al phases rather than diffusion of Mo into Al. In this case, it is more difficult to quantify the dependence of mixing efficiency on dosage.

## Self-Sustained Oscillations Due to Orifices; Phase IV: Conclusion

Researcher: Professor Samuel A. Elder  
Sponsor: Naval Sea Systems Command

This is the final chapter of a three-year investigation of self-sustained oscillations due to orifices. Funding was supplied to spend the summer of 1987 wrapping up loose ends of projects supported by Naval Sea Systems Command over the last few years. Several publications remain to be written based on data accumulated in the U.S. Naval Academy High Speed Tow Tank and The Acoustics Laboratory Blowdown Water Tunnel. One project involves the development of a theoretical model of

underwater shear tones associated with flow over orifices, and the other has to do with pfeiffenton phenomena associated with flow through orifices. Progress was made in working up data from earlier tests. Additional tests will be needed to complete the work. It is expected that these will be performed, on a non-funded basis, using equipment acquired under previous contracts. There is no set time for completion.

## PHYSICS

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### A Propagator Study of Resonance Phenomena

Researcher: Assistant Professor John P. Ertel  
Sponsor: David Taylor Research Center, Code 2704 1, Annapolis Laboratory

This study involves the first and second level development of the Propagator Solution to several standard idealized acoustics problems in physics. In the first level, some simple physics problems normally solved via eigenvalue methods were completed to validate the technique unambiguously. These problems have very well known and accepted solutions, which the Propagator method will reaffirm. This first level should be completed during the summer intersessional period under Code 2704.1

funding. At the second level of this project, several very idealized eigenvalue resonance problems (examples: a perfectly symmetric  $n$ -bladed propeller, perfectly evenly spaced ribs on a ribbed hull, etc.) will be solved using the Propagator method, which may then very matter-of-factly be extended to include deviations in symmetry. The well-known perturbation methods of extending the standard eigenvalue solutions are, in contrast, long, difficult, and in many cases, fail to converge reliably.

### Deep Water Range Studies

Researcher: Associate Professor William E. Fasnacht  
Sponsor: David Taylor Research Center, Annapolis Laboratory

This is a study of the requirements for, and the

performance of, a deep water magnetic test range.

### Low Temperature and High Pressure Electrical Properties of Ion Conducting Polymers

Researchers: Professor John J. Fontanella  
and Associate Professor Mary C. Wintersgill  
Sponsor: Office of Naval Research

The principal objective of the work is to measure the low temperature and high pressure electrical properties of ion-conducting polymers. In support of these studies, thermal and mechanical properties will also be measured as a means of materials characterization.

Audio frequency electrical measurements will be performed in vacuum from about 0.008 to 400 K using a state-of-the art complex impedance bridge, and at pressures of several kilobars over the temperature range 100-400 K. Thus electrical trans-

port and electrical relaxation will be studied, along with the associated activation volumes. The very low temperature studies will allow the observation of electrical quantum phenomena.

Some of the newly reported ion-conducting polymers such as polyphosphasene based material, poly(ethylene adipate), or poly{ethylene imine} will be studied. In addition, work will continue on the more traditional ion-conducting polymers, PEO, amorphous PEO, and PPO.

## PHYSICS

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### Analysis of Layered Structures by Rutherford Backscattering

Researcher: Assistant Professor James R. Huddle  
Sponsor: Naval Research Laboratory, Code 4672

Progress continues in developing a method for analyzing multilayered thin films using Rutherford Backscattering Spectrometry (RBS). The method uses a magnetic spectrometer to measure the energies of energetic helium ions elastically scattered from target atoms. Spectra of helium ions scattered from a 31 Å Nb/26 Å C x-ray analyzer were fit to theoretical predictions provided by the Rutherford Backscattering Spectrometry simulation program (RUMP) with reasonable results.

At present, the researcher uses a solid state surface barrier ion detector to detect ions passing through the magnetic spectrometer in a "single channel" mode. In order to speed data collection

and to reduce systematic degradation of the targets by radiation dose effects, he attempted to use a position-sensitive surface barrier ion detector to detect the scattered ions in a multichannel mode. The position sensitive detector was found to be possessed of a different nonlinearity, which caused a systematic error in the data. Possible causes of the nonlinearity were identified, and an investigation into these causes was initiated in order to learn how to correct for them. In addition, the feasibility of using a rectangular chevron channeltron electron multiplier array for the position-sensitive detection is being studied.

### Magnetic Modelling

Researcher: Professor Frank L. Miller  
Sponsor: David Taylor Research Center, Annapolis Laboratory

This project involves continued, classified research

on mathematical modeling of steel structures.

### Phase Conjugating Materials

Researcher: Assistant Professor Steven R. Montgomery  
Sponsor: Naval Academy Research Council (ONR)

This research is aimed at understanding the phenomenon of optical phase conjugation in crystals and developing new phase conjugating materials. An optical phase conjugator can be thought of as a mirror that sends a reflected beam of light exactly along the incident beam but in the opposite direction. Since the wavelength regime over which these materials will respond has been restricted to the visible, a major thrust in the research has been the development of materials that will phase conjugate at longer wavelengths in order to make them compatible with solid state lasers.

A dye laser system capable of operating over a wide range of wavelengths is being developed to

continue these investigations in Michelson B-10. The results to date will be presented in a paper entitled "Self-Pumped Phase Conjugation in the Red in Photorefractive SBN and BSKNN with Cerium in 9-Fold Coordinated Sites," appearing in the August 1988 issue of the *Journal of the Optical Society of America B*.

This work is a collaborative effort with researchers at Rockwell International, the University of Arkansas, and the U.S. Army Center for Night Vision and Electro-Optics.

# PHYSICS

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## Vector Multiplier

Researcher: Assistant Professor Eugene P. Mosca  
Sponsor: Naval Research Laboratory, Code 6530

This project is a performance evaluation of a prototype vector/matrix processor, using highly parallel optical architecture. The design objective is for a device that will perform vector matrix products at a rate of 100 KHz. The 128 elements of both the input and output vectors, as well as the 128 x 128

elements of the matrix, are complex numbers whose real and imaginary parts are each 8 bit signed numbers. While such a processor may be used for any linear transformation, the immediate interest is in the computation of discrete Fourier transforms. A performance report is being prepared.

## Fiber Optic Sensor

Researcher: Associate Professor David A. Nordling  
Sponsor: David Taylor Research Center, Code 2758, Annapolis Laboratory

The work accomplished during summer 1987 was preliminary toward experimental investigation into using Faraday rotation for current and voltage sensors in fiber optics.

The main accomplishment was to establish a laboratory work environment in fiber optics. The experimental work has subsequently been continued.

## HF/DF Laser Analysis

Researcher: Professor Charles W. Rector  
Sponsor: Naval Research Laboratory, Code 6540

The researcher prepared a list of all reliable fundamental and overtone spectral lines likely to be emitted by an HF laser. In this database are indicated both source and estimated reliability. The gaps remaining will have to be filled by either experimental (unlikely) or theoretically obtained

lines. A study is being made of the most recent approaches to the computer fitting of expansion coefficients to known spectral lines so as to be able to interpolate and extrapolate lines not yet observed experimentally. The process can be used to obtain DF lines as well.

## Deep Level Transient Spectroscopy

Researcher: Professor Robert N. Shelby  
Sponsor: Naval Research Laboratory, Code 6871

This study is part of a continuing program at NRL to investigate the properties of III-V Semiconductors. The emphasis of this work is on GaAs and  $Al_x Ga_{1-x}$  As systems. Deep level transient spectroscopy and thermally stimulated capacitance

techniques were used to study electronic defects in P-type  $Al_x Ga_{1-x}$  As samples. A set of previously unreported meta stable hole traps were discovered in MBE samples, and a report on their measured characteristics is in preparation.

## Transient Raman Scattering

Researcher: Associate Professor Lawrence L. Tankersley  
Sponsor: Naval Research Laboratory, Code 8540

The Transient Raman Group at the Naval Research Laboratory includes M. Duncan, R. Mahon, J. Reintjes, and L. L. Tankersley. This group is continuing a broad study of stimulated Raman scattering in the transient regime. Areas currently

under study include wavefront preservation, threshold statistics, multiple pulse effects, and higher order Stokes generation.

A tangential project is a study of asymmetric feedback rings as applied to unstable resonators.

## Permittivity of Materials

Researcher: Associate Professor Mary C. Wintersgill and  
Professor John J. Fontanella  
Sponsor: DuPont Company

The objective was to measure the audio frequency dielectric permittivity of various materials. Several polymers and aluminum phosphate were studied.

The latter solid is of interest as a transducer material. Signals were observed in aluminum phosphate which correlate with the water content.

## Nonlinear Sound Scattering of Focused Crossed Beams in The Presence of Turbulence

Researcher: 1/C Midshipman Stephen C. Rife, USN  
Adviser: Associate Professor Murray S. Korman  
Sponsor: Trident Scholar Program

Experiments were performed involving the interaction of mutually perpendicular crossed ultrasonic beams overlapping and interacting in the presence of turbulence in water. The turbulence was created by a  $d = 0.64$ -cm-diam submerged water jet with nozzle exit velocity 13.3 m/s. A profile of sum frequency pressure  $p_+$  versus distance, with characteristics of turbulent velocity, was determined by scanning across the width of the jet with the two cw acoustic beams (of frequencies  $f_1 = 1.9$  MHz,  $f_2 = 2.1$  MHz) focused on a point in the jet. The focal lengths were 15.2 cm for both sending units. In scanning, the receiving transducer unit (unfocused and located 15.2 cm from the inter-

action region) moves along with the senders so that propagation distances never change. The receiver axis is perpendicular to the jet. Scattered sum frequency pressure profile scans (at distances of 16d and 34d from the nozzle) compared well with known values of the radial turbulent rms velocity profile. Statistical properties of skewness  $s$  and kurtosis  $k$  from fluctuations in  $p_+$  were measured as a function of radial distance. Radial scans of the frequency spectrum of the scattered sum frequency intensity exhibited Doppler shifts about the value fit  $f_2$  and frequency broadening. This information was used to characterize the radial distribution of mean and turbulent velocity across the jet.

## Electron Irradiation-Induced Defects in $Al_xGa_{1-x}As$

Researcher: Midshipman 1/C Wesley I. Summers, USN

Adviser: Professor Robert N. Shelby

Sponsor: Trident Scholar Program

This study analyzed two Liquid Phase Epitaxy (LPE) grown  $Al_xGa_{1-x}As$  samples. One sample was electron irradiated with 1 MeV electrons; the other sample was non-irradiated. The goal of this study was to see the effect of the electron irradiation and characterize any trapping states encountered. Deep Level Transient Spectroscopy (DLTS) was used to analyze the samples. Only one trap was encountered in the non-irradiated sample, the so called DX center [1], while eight states were found

in the irradiated sample, including the DX center. From a discussion of the experimental results, it is concluded that the electron irradiation had no noticeable effect on the DX center, that the irradiation was responsible for the additional trapping states encountered in the irradiated sample, and that point defect modeling is accurate in characterizing the five of the seven irradiation induced states. A summary of the DLTS trap parameters is given.



# Independent Research

## Electron Mobility in Moist Air at Low Densities and Strong Electric Fields

Researcher: Professor Rutherford H. Adkins

The objective of this study is to determine electron mobility as a function of the moisture content of air at low densities in strong electric fields, near the point at which avalanche occurs.

This is a theoretical analysis of the problem. At low densities the electrons will acquire large values of kinetic energy and momentum, and experience inelastic collisions with the constituent molecules of the moist air. The researcher is attempting to eval-

uate the collision terms in the Boltzmann equation using cross-section properties reported in the literature and in the technical reports from Harry Diamond Laboratory and other laboratories.

The Boltzmann equation is linearized in the usual manner, and the distribution function is expanded in a series of Sonine polynomials and tested for convergence. Numerical solutions are obtained.

## Interstellar Gas in The Galactic Halo

Researcher: Associate Professor C. Elise Albert

The aim of this program, which is being carried out in collaboration with Dr. D. C. Morton, Director, Herzberg Institute of Astrophysics, and Dr. J. C. Blades, European Space Agency and Space Telescope Science Institute, is to carry out a high resolution spectroscopic study of interstellar gas in the galactic halo by observing the absorption lines of CaII, Ti II, and NaI superimposed on the spectra of high latitude stars. Spectra of more than 60 stars have now been obtained in two separate observing

runs with the 3.6 meter Canada - France - Hawaii telescope. Complementary spectra of neutral hydrogen emission were obtained in October 1987 with the 140-foot telescope of the National Radio Astronomy Observatory in Green Bank, West Virginia. The number of halo lines of sight probed at highest resolution has been more than tripled, and extensive data analysis is underway. Further observations are also planned.

## MIRV Interception Astrodynamics

Researcher: Lieutenant Michael J. Connolly, USN

Research at Los Alamos National Laboratory (LANL) included computer modeling on both Cray (CTSS) and VAX (VMS) computers. Two major research projects at LANL generally involved the physical analysis of various technical problems, translation of the physical equations into programmable models, and writing the new code (primarily in FORTRAN). Work also included optimization studies based on the computer codes developed, as well as modification and trouble shooting of some existing codes. A summary of both studies follows.

The "Laser Anti-Satellite (ASAT) System" was a technical feasibility study to predict the likelihood of the Soviets developing such a system. The researcher worked with an existing atmospheric transmission code and wrote additional code to model an entire ASAT system, including: power source and transmission efficiencies, optical pump-

ing and lasing efficiencies, atmospheric transmission, and required flux on target. Allowances were made for a range of variables in each step, and a number of program runs were performed to determine optimum design characteristics and capabilities. Results of this study were presented to a panel of scientists from various national laboratories involved in related work.

"MIRV Intercept Astrodynamics" was a Space Defense Initiative related study to simulate interception of Multiple Independently-targeted Reentry Vehicles (MIRV's) by defensively-launched MIRV'd kinetic kill ("shotgun") weapons. The investigator wrote a segment of code which modeled the astrodynamics involved in this interception and allowed the determination of optimum values for parameters such as launch time, weapon firing time, lead angles, and probability of hit.

## Upgrade of the United States Naval Academy Accelerator Laboratory

Researchers: Associate Professor Francis D. Correll and Assistant Professor James R. Huddle

The United States Naval Academy Physics Department is in the process of acquiring a new Tandem Accelerator as part of an upgrade of the present laboratory. The new lab will support four physics courses (SP301, SP234, SP425, and SP434), training about 250 midshipmen per year in modern, atomic, and nuclear physics. In addition, the lab will sup-

port midshipmen and faculty research projects in materials science, and atomic, nuclear, and solid-state physics.

The accelerator is expected to be delivered in the fall of 1988. The investigators are presently preparing the laboratory space and facilities to receive the new instrument.

## Magnetospheric Physics

Researcher: Associate Professor Irene M. Engle

The researcher adapted a set of orthogonal functions for three-dimensional representation of magnetospheres for earth and other planets with intrinsic planetary magnetic fields. The project also involved the formulation of a theory to explain the existence of a "sudden" physically extensive cometary ion tail in Kohoutek, as imaged by the NRL UV camera. Subsequently, the work sought through

modeling, from first principles, or by scaling from a function set, as in #1., to establish a self-consistent global magnetosphere of Uranus.

Finally, the researcher took a new look at the Mercury magnetospheric field, in response to a recently published review on Mercury which contains some conclusions which are not supported by this investigator's experience.

## An Automated Digitizing Processor

Researcher: Assistant Professor John P. Ertel

Current state-of-the-art digitizing tablets fall into two basic categories, depending on whether they sense position ultrasonically or through inductive coupling. The final intrinsic resolution of these devices, after interpolation, typically varies from about 0.05 to about 0.005 of an inch, depending on the model and price range. While any of these devices can be a tremendous aid in obtaining numerical information from a 2-D (dimensional) source, they all suffer from three distinct problems which are not likely to be either cured or alleviated by any redesign. These problems are: (1) difficulty in alignment of the 2-D article to be digitized to the "natural axes" of the tablet; (2) possible, if not probable, astigmatic distortions of the source article due to photographic or xerographic reproduction; and (3) possible nonorthogonality of the coordinate axes of the source article.

A two-step method has been developed to address these problems through software processing of the

output of the digitizer in which fiducial marks, chosen by the operator, are digitized. This information is sufficient to calculate up to quadratic tensor corrections to adjust for astigmatism and lack of internal orthogonality. Additionally, a coordinate rotation is effected yielding proper x-y data pairs for the digitized object. A third step is added to scale the output within the x and y ranges specified by the operator.

The software for the above transformations has been written in PASCAL, FORTRAN, and BASIC and may be easily translated to any other high level language. Pseudo-macro versions of this software have recently been developed to allow a similar translation into the typical assembler. Handlers for several digitizer/microcomputer configurations have also been developed.

## A Study of Photogates Photogates: An Instrumentation Evaluation of Measurements with Photogates

Researchers: Assistant Professors John P. Ertel  
and Eugene P. Mosca

Using commercially available photogates commonly used in laboratories, the researchers have conducted as complete a study as possible into the quality of this measurement device. The spatial as well as temporal sensitivities of these devices have been explored, showing some strengths/robustness, as well as many weaknesses, manifested in typical use. A "sweet area" was found, a spatial region which, while not centrally located as one might suspect,

allows the photogate to produce values which are significantly closer to the "true," micro-metrically measured, sizes of standard occluding objects. With the exception of some photogates which were obviously damaged and/or misaligned, the study revealed consistent underestimates in lengths measured by these devices of the order 10%, and sometimes 25% or higher.

## An Eye-Ball Fitting Processor

Researcher: Assistant Professor John P. Ertel

Development in this area has proceeded steadily for several years, awaiting the state-of-the-art to catch up and provide an adequate and acceptably priced computational and display environment. A real time interactive process has been developed for use in fitting multi-variate functions to experimental observations. The "fit" is generated real-time on any computer linked to any graphics display device either in color or on multiple two or more memory planes. First the graph frame (coordinate axes, tick marks, and axis labeling) is drawn, followed by the data and appropriate error bars. These are frozen

in one color or memory plane. Next, the proposed algorithm or model is evaluated over the range of the data to produce a curve in another color or memory plane, which may be dynamically varied according to the current values of the fit parameters. These two plots, one fixed and one changing, are superimposed on the user's display. Using joysticks or other input devices, the application user then "flies" the resulting curve to match the data, giving "the most optically pleasing" fit while monitoring the reduced- $\chi^2$ .

## Phenomenological Parameterization of the T=1 Levels in Carbon-12 Through the Generalized Helm Model

Researcher: Assistant Professor John P. Ertel

The techniques of the phenomenological fitting procedure have been used to understand the geometrical interaction between the radial density, Gaussian shape, and "strength" parameters of the Generalized Helm Model. These sets of parameters

were used as seeds in a new streamlined nonlinear regression processor to yield robust matrix elements for both the Electric Longitudinal and Transverse as well as the Magnetic Transverse levels of Carbon-12.

# PHYSICS

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## New Laboratory Experiments for SP324-425

Researcher: Assistant Professor James R. Huddle

A package of spectroscopy experiments for the Physics of the Atom sequence of courses for physics majors (SP324-425) is under development. The package will include experiments performed in the visible portion of the electromagnetic spectrum using a variety of spectrometers ranging from a rudimentary spectrometer assembled from "spare parts" to a research quality high-resolution two meter Czerny Turner type instrument. Under devel-

opment are experiments dealing with a variety of phenomena, including the Lande' interval rule, the normal and anomalous Zeeman effects, and fine structure and hyperfine structure in hydrogen. "First-revision" experiments dealing with the hydrogen hyperfine structure and the Zeeman effect have already been incorporated into the course sequence.

## Sonar Project Laboratory for Undergraduates

Researcher: Associate Professor Murray S. Korman

A portable microcomputer workstation for supporting basic acoustic experiments has been developed over the past three years in the Physics Department at the United States Naval Academy. Students enrolled in "Underwater Acoustics and Sonar" (a three hour lecture course without a laboratory) perform fundamental acoustics experiments in the classroom without having to utilize large numbers of analog electrical boxes. The heart of the workstation (based on the 6502 microprocessor) includes a low-cost, dual channel, 8 bit analog to digital board. This workstation features menued software that can capture a waveform and display its trace. Simple mathematical operations include squaring the waveform, integrating, differentiating, finding the rms value,

and determining the probability density function. A 1024-point FFT program is also included in the menu. Students are not required to know computer languages to operate the workstation, and no experiment is automated or simulated. During nonclass hours, students design an experimental project that might include "model" measurements of target strength, beam pattern functions, reflection loss, sound velocity, vibration, and studies of signals in noise. The workstation's versatility will be demonstrated. [High school senior Dan Magsig of the Anne Arundel County Gifted and Talented Mentorship Program contributed to this project by writing many of the computer programs used in the sonar course.]

# Research Course Projects

## Astrophotographs Techniques with USNA Telescopes

Researcher: Midshipman 1/C David J. Hoff, USN  
Adviser: Associate Professor C. Elise Albert

The purpose of this project was to develop techniques to utilize the Academy's existing equipment to take precise astrophotographs suitable for data

analysis. Four different telescopes were studied, and detailed results were written up as a manual for future midshipmen use.

## Scattering of A Focused Sound Beam by Turbulence

Researcher: Midshipman 1/C Mary M. Jackson, USN  
Adviser: Associate Professor Murray S. Korman

Experiments were performed involving the scattering of a cw beam of focused ultrasonic waves by turbulence in water. The turbulence is created by a  $d = 0.64$ -cm-diam submerged waterjet with a nozzle exit velocity of 13.3 m/s. A mechanical apparatus positions a focused beam of sound (of frequency 1.9 MHz) to scan across the width of the turbulent waterjet plume. The sending transducer unit has a focal length of 15.2 cm and is always directed at an angle of 45° to the jet axis and aimed "downstream." A transducer receiving unit (fixed relative to the sender) is directed perpendicular to the jet axis. This unit is unfocused and is located

15.2 cm from the focal point. The scattering angle between sender and receiver is 45° in the "upstream" direction. Profiles of scattered pressure  $p_s$  as a function of the radial scanning distance  $r$  were compared to known turbulent rms velocity profiles at distances of 16d and 34d from the nozzle exit. Measurements of the spectral broadening and Doppler shift of the scattered pressure taken at points across the width of the jet were used to predict the local values of the rms turbulent velocity and the mean jet velocity, respectively, across the width of the jet.

## Optimization of a TIS Scatterometer

Researcher: Midshipman 1/C Todd A. Kiefer, USN  
Adviser: Associate Professor Francis D. Correll

The purpose of this project was to test and improve the design of a total integrated scatter (TIS) instrument (an optical device used to measure the surface roughness of reflecting materials) which was constructed last year as part of the Trident research project of Midshipman Charles D. Ferguson, II.

As originally built, the TIS instrument was difficult to align, and seemed incapable of measuring mean roughness less than about 2 nm (even for samples which were believed to be much smoother). In addition, the effect on measured roughness of possible differences in sensitivity of its two light sensors and variations in its laser output was not sufficiently well understood. Finally, the instrument was physically large, a disadvantage for some applications.

In this work, the sensitivities of the two light sensors were measured as functions of incident light intensity, angle, and position. They were found to

be equal within 2%, contributing only about 4% to the uncertainty in measured roughness under typical operating conditions. In addition, while the laser output power was found to vary by 5% even after a long warm-up period, it was shown that the measured roughness was essentially insensitive to such variations because of the timing and sequence of intensity measurements. More significantly, the sample stage and several mirrors were redesigned to better position the sample and one detector, and to reduce scattered light. The results were a much simplified alignment procedure and a demonstrated ability to measure roughness as low as 0.6 nm.

As a result of this work, the TIS instrument is more sensitive, easier to align and use, and generally better understood than before. In addition, its present design is better suited to planned future miniaturization, which may make it more versatile.

## Photometry of RS Canum Venaticorum Stars

Researcher: Midshipman 1/C Karen B. Povlock, USN  
Adviser: Associate Professor C. Elise Albert

The RS Camera Venaticorum variable stars are close binary systems whose subgiant component rotates rapidly enough to produce extreme solar-type surface phenomena. The systems' light variations are attributed to large, concentrated groups of "star spots." This project used the Michel-

son 16" reflecting telescope and UBV photo-electric photosmeter to study the light curves of two such RS CVn stars. A good period was obtained for the variable Sigma Geminorum, providing the basis for a continued analysis of star spot properties.



# Publications

BEAM, David A., Lieutenant, USN, Mary C. WINTERSGILL, Associate Professor, and John J. FONTANELLA, Professor, "Electrical Relaxation in Calcium Fluoride doped with Thorium and Zirconium," *Crystal Lattice Defects and Amorphous Materials*, **15** (1987), 363-369.

Audio frequency electrical relaxation measurements have been performed on  $\text{CaF}_2:\text{TH}$  and  $\text{CaF}_2:\text{Zr}$ . The nominal concentrations in both cases are 0.1 and 1.0 mol-%. The measurements have been carried out over the temperature range 5.5 to 400 K using a fully automated dielectric spectrometer operating at seventeen frequencies from 10 to 100,000 Hz. The spectrum for the 0.1 mol-% thorium doped material consists of two relatively strong relaxations along with three weak relaxations. For the 1.0 mol-% material, the high temperature relaxation, if it exists, is masked by the DC conductivity. Only small changes in the relaxations are noted with a change in the nominal concentration. For 0.1 mol-%  $\text{CaF}_2:\text{Zr}$ , seven relaxations are observed, all of which appear to be important, as significant changes in the spectrum are observed when the nominal concentration is increased to .0 mol-%. Models for some of the complexes responsible for the relaxations are presented.

BRILL, Donald W., Professor, co-author, "The Influence of Natural Resonances on Scattering and Radiation Processes," *Journal of the Washington Academy of Sciences*, **77**, 2 (June 1987), 55-65.

Resonances present in the many physical processes associated with radiation and scattering phenomena are being used in many applications ranging from radar target masking to sonar target identification.

CALAME, Gerald P., Professor, co-author, "Pump Replication and Related Effects in Raman Beam Cleanup," *SPIE*, **739** (January 1987), 162-168.

Conditions under which pump beams replication can occur in Raman Beam cleanup with crossed pump beams are examined. The dependence of pump beam replication on the small signal Raman gain and on the Stokes seed energy is explored.

CORRELL, Francis D., Associate Professor, co-author, "Study of the Reaction  $\text{H}(\text{d},2\text{p})\text{n}$  at 16 MeV Around Collinear Configurations," *Nuclear Physics*, **A475** (1987), 407- 421.

The cross section and the analyzing powers  $A_{\text{yy}}$ ,  $A_{\text{yy}}$ , and  $A_{\text{yy}}$  for the reaction  $\text{H}(\text{d},2\text{p})\text{n}$  are studied

by kinematically overdetermined measurements at an incident energy of 16 MeV at collinear and somewhat off-collinear kinematic conditions. A three-body Faddeev model using two realistic separable potentials that have different short-range parts gives a good fit to the data. Uncertainties in Coulomb corrections make it difficult to draw definitive conclusions about possible three-nucleon force effects at collinearity conditions.

ERTEL, John P., Assistant Professor, "FLY YOUR OWN FIT (or Game Graphics Techniques Come to Modeling)," *Proceedings of the Eighteenth Annual Pittsburgh Conference on Modeling and Simulation, IEEE*, Volume 18, pp. 1719-1721.

Techniques are described which allow the user to "fly" a model dependent curve in to match the available data and obtain an optically pleasing "fit." While this "fit" has no obvious statistical merit, the author found that "fits" that look good are almost always statistically better than those that don't look as good.

At the very least this method provides two possibilities that were previously unavailable: (1) By flying/playing with the curve, the application user may obtain a feeling for the sensitivity of a given model to changes in a particular parameter and for the possible "interaction" of two or more of the model parameters; (2) at a very low computational cost, the application user can obtain "good seeds" which lie within physically meaningful limits for the standard (and typically very costly) regression to the available data. Also, the user can look for and therefore avoid possible "traps" (parameter values which are not physically meaningful but may yield pathologically lower values of reduced- $\chi^2$ ).

While originally developed for small microcomputers to enable them to produce real-time animation with a smooth (non-jerky) display for such games as *Flight Simulator*<sup>TM</sup> and *Space Invaders*<sup>TM</sup>, these methods are easily adapted to the requirements of a real time fitting" procedure. These techniques can deliver low cost fitting/modeling to all users with microcomputer capability and, at the same time, give the investigator a better feeling of the range of applicability of his model.

FONTANELLA, John J., Professor, and Mary C. WINTERSGILL, Associate Professor, "DR, TSDC, DSC, TMA, and DMA Studies in Polymers Complexed with Inorganic Salts," *Proceedings of the Sixteenth North American Thermal Analysis Society*, 27-30 September 1987, pp. 46-51.

In the present note, the relationship between audio frequency dielectric relaxation (DR) and thermally stimulated depolarization current (TSDC) techniques is described. In addition, those methods are compared with differential scanning calorimetry (DSC), thermo-mechanical analysis (TMA), and dynamic mechanical analysis (DMA). The discussion proceeds using data taken on cast film samples of PAREL (Hercules, Inc.) elastomer, the major constituent of which is poly(propylene oxide). The relation of the work to the topic of polymer electrolytes is discussed briefly.

MONTGOMERY, Steven R., Assistant Professor, co-author, "Self-Pumped Phase Conjugation in the Red in Photorefractive SBN and BSKNN with Cerium in the 9-Fold Coordinated Sites," *Journal of the Optical Society of America*, **B**, 5 (August 1988), 1775.

Self-pumped phase conjugation was observed at selected laser wavelengths over the range from 647 to 780 nm. Previous observations of self-pumped phase conjugation in these materials, which are members of the tungsten-bronze family, had not been possible at these wavelengths. By doping the crystals with cerium and controlling the growth so that the cerium occupies 9-fold coordinated sites the self-pumped phase conjugate response was extended to the aforementioned wavelengths for the first time.

MOSCA, Eugene P., Assistant Professor, "Photogates: An Instrument Evaluation," *Bulletin of the American Physical Society*, **4/1** (January 1988), 55.

The effective length of a flag executing photogate transit varies from photogate to photogate. It also varies with the position in the gap where it crosses the beam and with the speed of the flag. Measurements were made using 25 photogates (the PASCO Model 9204 and its newly updated version, Model 9204A), along with PASCO's 11.63 mm diameter cylindrical flags. The effective length of the same flag was found to: vary from photogate to photogate by up to 20%; vary with gap position by up to 8%; and decrease by approximately 0.2% per m/s with flag speed. Measurements and analysis are presented, along with suggestions for minimizing systematic errors when using photogates in the laboratory.

TANKERSLEY, Lawrence L., Associate Professor, co-author, "A Study of Transient Raman Amplification in H<sub>2</sub>," *Journal of the Optical Society of America*, **B**, 5 (1988), 37.

This article describes the results of an extensive study of transient stimulated Raman scattering in hydrogen gas. Measurements of self-oscillation thresholds, conversion efficiency, and the dependence of small-signal amplification on the pump and seed-Stokes pulses, on their relative time of arrival at the Raman amplifier, and on the seed-Stokes pulse asymmetry have been observed. The experimental measurements are compared with theoretical predictions that are based on extensions of published transient theories to take into account the spatial and temporal profiles of the pulses as well as their phase modulation. Excellent agreement with the theory, especially with regard to the scaling of the small-signal amplification with pump-pulse energy, is obtained when all the specific characteristics of the pump and Stokes pulses are included in the calculations.

TANKERSLEY, Lawrence L., Associate Professor, co-author, "Rotational Raman Gain Suppression in H<sub>2</sub>," *Optics Communications*, **64** (1987), 467.

The author reports measurements of rotational Raman suppression in H<sub>2</sub> in the transient regime. Quantitative information about the dependence of the amount of the gain suppression on the pump energy and the propagation angle relative to the pump beam is obtained from angularly resolved measurements of the small signal amplification. These measurements, along with qualitative observations of the Stokes spatial distribution under different gain conditions, demonstrate that the gain suppression is confined to a narrow region around the phase matching angle for collimated beams with relatively low gain per unit length. For focused beams with higher gain per unit length, the suppressed region can extend to the forward direction, resulting in a two to three-fold estimated increase in the Raman threshold.

TANKERSLEY, Lawrence L., Associate Professor, co-author, "Narrow-linewidth Unstable Resonator," *Optics Letters*, **13** (July 1988), 568-570.

The article describes the use of an asymmetric feedback ring in an unstable resonator to obtain arbitrarily narrow line-width radiation across the full available aperture. The author demonstrated its use with an electric-discharge XeCl laser to produce single-line radiation with a linewidth of 0.15 cm<sup>-1</sup>.

WINTERSGILL, Mary C., Associate Professor, John J. FONTANELLA, Professor, and David A. BEAM, Lieutenant, USN, "Electrical Relaxation in Rare Earth Doped Cadmium Fluoride," *Crystal Lattice Defects and Amorphous Materials*, 15 (1987), 387-393.

Audio frequency electrical relaxation measurements have been carried out over the temperature range 5.5 to 300K on  $\text{CdF}_2$  doped with various concentrations of yttrium and eleven rare earths. Several relaxations are observed, some of which are described in the present work. In contrast to rare earths in the alkaline earth and lead fluorides (and alkali metals in the alkaline earth, lead, and cadmium fluorides), no regularity is observed. However, three trends are suggested by the data, none of which is without exception: First, the samples exhibit very little relaxational behavior for low concentrations. This implies that rare earths in cadmium fluoride, in general, do not form simple rare earth fluorine interstitial pairs. Second, most of the relaxations occur for higher concentrations, which suggests the presence of clusters. Finally, the room temperature electrical conductivity is relatively high (about  $10^{-6}$  ohm-cm<sup>-1</sup>) for most low concentration materials and tends to decrease with increasing concentration. This is consistent with the first two conclusions if at low concentrations rare earths are incorporated into the lattice in cubic sites, and the conductivity is due to either the non-local charge compensators or electrons. At high concentrations, then, the mobile charges either become trapped, or their mobility is simply reduced by the clusters. This model agrees with the conclusions of Mho and Wright for  $\text{CdF}_2:\text{Eu}$  on the basis of site selective laser excitation studies. For  $\text{CdF}_2:\text{Eu}$ , a relaxation is found which correlates both with the B site of Mho and Wright and the principal ITC peak of Capelletti et al. This correlation sheds doubt on the assignment of the ITC peak.

WINTERSGILL, Mary C., Associate Professor, and John J. FONTANELLA, Professor, "NMR, DSC, DMA, and High Pressure Electrical Conductivity Studies in PPO Complexed with Sodium Perchlorate," *Journal of the Electrochemical Society*, 135 (January 1988), 235-238.

Audio Frequency electrical conductivity, DSC, DMA, and  $^{23}\text{Na}$  NMR measurements have been carried out on Parel 58 elastomer complexed with sodium perchlorate. (As the primary constituent of Parel 58 is poly(propylene oxide) (PPO), it is referred to as PPO.) The DSC and DMA measurements yield similar values for  $T_g$ , which are about 72° C higher than the "central"  $T_g$  for uncomplexed PPO. In addition, the DSC studies show that the sodium perchlorate is insoluble above about 140° C. The conductivity measurements have been carried out in vacuum over the temperature range 290-380K and at pressures up to 0.65 GPa from 315-370K. From a VTF analysis  $E_a$  is found to be about 0.09 eV and  $T_o$  is found to be about 45° C below the central "glass transition temperature," which is the same behavior observed previously for PPO complexed with lithium salts and for the alpha relaxation in uncomplexed material. In addition, it is found that the vacuum activation volumes for the electrical conductivity and the alpha relaxation are approximately the same when compared relative to  $T_o$ . The  $^{23}\text{Na}$  NMR measurements reveal the presence of both bound and mobile sodium species, the relative concentrations of which change by about a factor of ten over the temperature range -90 to +90° C. In addition the mobile  $^{23}\text{Na}$  resonance becomes motionally narrowed above  $T_g$ . The NMR results, combined with the conductivity data, imply that large scale segmental motions of the polymer chain represent the ion transport mechanism.

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## Presentations

ALBERT, C. Elise, Associate Professor, "A Tour of the Universe," Theosophical Society of Baltimore, Baltimore, Maryland, 25 October 1987.

BEAM, David A., Lieutenant, USN, Mary C. WINTERSGILL, Associate Professor, and John J. FONTANELLA, Professor, "Amorphous Phase Separation, Salt Precipitation, and High Pressure Effects in PPO Containing NaI," 172nd Meeting of the Electrochemical society, Honolulu, Hawaii, 18-23 October 1987.

BEAM, David A., Lieutenant, USN, Mary C. WINTERSGILL, Associate Professor, and John J. FONTANELLA, Professor, "Electrical Conductivity, Dielectric Relaxation, DSC and NMR Studies in Amorphous Poly(ethylene oxide) Complexed with Alkali Metal Salts," 1988 March Meeting of the American Physical Society, New Orleans, Louisiana, 21-25 March 1988.

CALAME, Gerald P., Professor, co-author, "Multiple Pulse Effects in Transient Raman Amplification," SPIE Symposium on Lasers and Optics, Los Angeles, California, 11 January 1988.

CALAME, Gerald P., Professor and Lawrence L. TANKERSLEY, Associate Professor, "Stimulated Raman Scattering with Pulse Trains of Alternating Signs," Optical Society of America Annual Meeting (OSA), Rochester, New York, 18-23 October 1987.

CALAME, Gerald P., Professor, and Lawrence L. TANKERSLEY, Associate Professor, "Multiple Pulse Effects in Transient Raman Amplification," The International Society for Optical Engineering 1988 Symposium (SPIE OE LASE 88), Los Angeles, California, 11-15 January 1988.

ELDER, Samuel A., Professor, "Project-type Acoustics Experiments in the USNA Acoustics Lab," Meeting of the Acoustical Society of America, Miami, Florida, 18 November 1987.

ELDER, Samuel A., Professor, and Murray S. KORMAN, Associate Professor, "Creation of Experiment-oriented Materials to Enhance a Non-lab Acoustics Elective," Meeting of the Acoustical Society of America, Seattle, Washington, 20 May 1988.

ENGLE, Irene M., Associate Professor, "Advanced Placement Physics," Conference of Physics Teachers, Houston, Texas, 6 November 1987.

ERTEL, John P., Assistant Professor, "Fly Your Own Fit (or Game Graphics Techniques Come to Modeling)," Eighteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 24 April 1987.

ERTEL, John P., Assistant Professor, "Phenomenological Fitting Procedures and the Fast Micro/PC," Computational Physics in the Undergraduate Curriculum, A Conference and Workshop, University of North Carolina, Asheville, North Carolina, 15 October 1987.

ERTEL, John P., Assistant Professor, "Fly Your Own Fit (A Cybernetic Method of Modeling)," Annapolis Chapter of Sigma Xi, Officers and Faculty Club, United States Naval Academy, Annapolis, Maryland, 17 February 1988.

ERTEL, John P., Assistant Professor, "An Automated Digitizing Processor," Nineteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 5-6 May 1988.

FONTANELLA, John J., Professor and Mary C. WINTERSGILL, Associate Professor, "TSDC and DR Studies in PEO Complexed with Inorganic Salts," Sixth International Conference on Solid State Ionics, Garmisch-Partenkirchen, West Germany, 6-11 September 1987.

KORMAN, Murray S., Associate Professor, "Sonar Project Laboratory for Undergraduates," 114th Meeting of the Acoustical Society of America, Miami, Florida, 16-20 November 1987.

KORMAN, Murray S., Associate Professor, and Stephen C. RIFE, Midshipman 1/C, USN, "Non-linear Sound Scattering of Crossed Focused Beams in the Presence of Turbulence," 115th meeting of the Acoustical Society of America, Seattle, Washington, 16-20 May 1988.

KORMAN, Murray S., Associate Professor, and Mary M JACKSON, Midshipman 1/C, USN, "Scattering of a Focused Sound Beam by Turbulence," 115th Meeting of the Acoustical Society of America, Seattle, Washington, 16-20 May 1988.

MONTGOMERY, Steven R., Assistant Professor, co-author, "Self-Pumped Phase Conjugation in the Red in SBN and BSKNN," Topical Meeting on Photorefractive Materials, Effects, and Devices, Los Angeles, California, 12 August 1987.

## PHYSICS

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MOSCA, Eugene P., and John P. ERTEL, Assistant Professors, "Photogates: An Instrumentation Evaluation," Joint Annual American Physics Society/American Association of Physics Teachers Winter Meeting, Crystal City, Virginia, 26 January 1988.

MOSCA, Eugene P., Assistant Professor, "Photogate: An Instrument Evaluation," 1988 Annual Joint Meeting of the American Physical Society/American Association of Physics Teachers, Crystal City, Virginia, 26 January 1988.

SHELBY, Robert N., Professor, co-author, "Particle Induced Switching of Josephson Tunnel Junctions," Workshop on Superconductive Particle Detectors, Toreno, Italy, 26-29 October 1987.

SHELBY, Robert N., Professor, and Lawrence L. TANKERSLEY, Associate Professor, "A Simple Quantitative Measurement of the Coulomb Force," American Association of Physics Teachers, Summer Meeting, Bozeman, Montana, June 1987.

TANKERSLEY, Lawrence L., Associate Professor, co-author, "Phase Pulling (and Statistical Behavior) in a Transient Raman Amplifier," The International Society for Optical Engineering 1988 Symposium (SPIE OE LASE 88), Los Angeles, California, 11-15 January 1988.

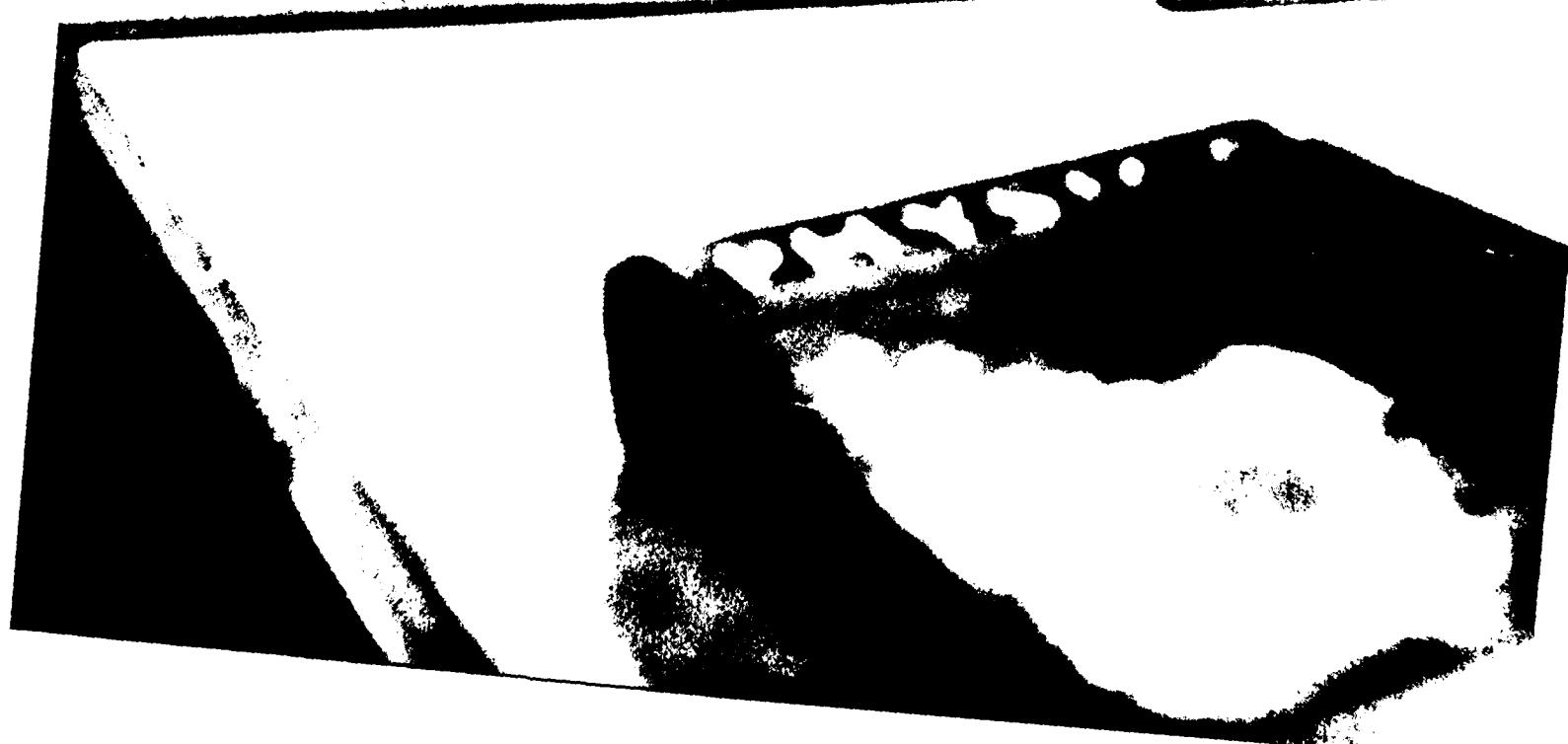
TANKERSLEY, Lawrence L., Professor, co-author, "Wavefront Studies in a Transient Raman Amplifier," Optical Society of America Annual Meeting (OSA), Rochester, New York, 18-23 October 1987.

WINTERSGILL, Mary C., Associate Professor, and John J. FONTANELLA, Professor, "DSC, Electrical Conductivity, and NMR Studies of Salt Precipitation Effects in PPO Complexes," International Symposium on Polymer Electrolytes, St Andrews, Scotland, 17-19 June 1987.

WINTERSGILL, Mary C., Associate Professor, and John J. FONTANELLA, Professor, "DR, TSDC, DSC, and DMA Studies in Polymers Complexed with Inorganic Salts," Sixteenth North American Thermal Analysis Society Conference, Washington, DC, 27-30 September 1987.

WINTERSGILL, Mary C., Associate Professor, and John J. FONTANELLA, Professor, "NMR, DSC, TMA, and High Pressure Electrical Conductivity Studies in Solid, Crosslinked Dimethylsiloxane-ethylene-oxide Copolymer Networks Containing Sodium," Symposium on Electroresponsive Polymers, Brookhaven National Laboratory, Upton, Long Island, New York, 4-7 October 1987.

WINTERSGILL, Mary C., Associate Professor, and John J. FONTANELLA, Professor, "NMR, DSC, and Electrical Conductivity Studies of MEEP Complexed with Sodium Triflate," Sixth International Conference on Solid State Ionics, Garmisch-Partenkirchen, West Germany, 6-11 September 1987.



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Division of  
Professional Development



DEPARTMENT OF

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# Leadership and Law

Commander Peter A. Scala, USN  
Chairman

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The Department of Leadership and Law, within the Division of Professional Development, is responsible for preparing young men and women for the transition from civilian to commissioned officer, ready to assume successfully the responsibilities of a leader in the Naval service. Because the Division of Professional Development is organized under the Commandant of Midshipmen, research conducted by the Department must in some way contribute to the mission of the Naval Academy. This requirement to further develop midshipmen is what distinguishes our research from that of the other academic divisions. To this end, research in the Department seeks to improve the quality of education of the midshipmen and to gain insight to the character and behavior associated with leaders and followers.



## Sponsored Research

### Coronary Artery Disease, Type-A Behavior Patterns, and Naval Academy Midshipmen

Researcher: Associate Professor Eric D. Bowman  
Sponsor: Naval Academy Research Council (ONR)

This research project, a continuation of a 1987 NARC-funded project, is concerned with Type-A behavior patterns. Behavioral medicine literature has consistently shown that individuals with Type A behavior are ambitious, show marked aggressive traits, deal chronically with time urgency, and appear to have a strong need for control. It is also suggested in the literature that the Type-A behavior pattern appears to be a major risk factor in the development of coronary artery disease.

This research, to be conducted during the 1988 summer session, will be a continued examination of the prevalence of Type-A behavior patterns within

the incoming midshipmen Class of 1992. All midshipmen in the class of 1992 will be tested as part of the existing Background Psychological Testing Program coordinated through the Division of Professional Development.

The accumulation of this data will allow a more complete evaluation of the prevalence of Type A behavior at the Naval Academy and will enable more complete tracking of the midshipmen through their fourth class year. Variables examined will include military and academic performance, injury and illness proneness, and attrition.



# Independent Research

## What is This Thing Called Charisma?

Researcher: Assistant Professor Leanne Atwater

This research, begun with Professors Robert Penn and Linda Rucker, colleagues at San Diego State University, was completed. The study investigated the components of charismatic leadership. While charisma has been identified as an important aspect of good leadership for many years, the exact qualities required for charismatic leadership are not well known. The specific purpose of this project was to identify personal characteristics associated with charisma.

Questionnaires assessing subjects' perceptions of 250 potential characteristics of charismatic leaders were administered to 35 military officers and 50

civilians. Results indicated that all charismatic leaders were seen as sociable (extroverted and outgoing) as well as competent (e.g., skillful and resourceful). Military subjects evaluating charismatic military leaders additionally described charismatic leaders as rugged or masculine (e.g., demanding, mechanical, unflappable) and responsible (e.g., prudent, ethical, wholesome). These results suggest that while a number of characteristics appear to be common to charismatic leaders in different contexts, charismatic leaders in a military context are described by additional factors.

## Development of an NL303 Leadership Case Book

Researchers: Lieutenant Commander C. Randy Large, USN, and  
Professor Karel Montor

Case review and refinement continued with cases available for instructor use during AY 1988-1989. While further developmental work will continue on

the cases, this will be the last report. The cases represent leadership situations that happened to "real world" officers.

## Development of Professional Training Programs

Researcher: Professor Karel Montor

Brigade training activities continued to be an area of focus for the researcher, with results of Plebe testing indicating that those running the Brigade professional training are definitely doing something right. Work has started, and will continue into next

year, towards improving discipline in the Brigade, assuring that female midshipmen are treated with equal respect as are the men, in accordance with the sincere wishes of all senior personnel in the military.

## Developing A Myopia Avoidance Protocol and Research Program

Researcher: Professor Karel Montor

A small intervention study was started this past year with an outstanding assist effort from Bancroft Hall Medical, who did the eye testing and ordering and supplying of lenses for midshipmen to wear. The object of the study was to evaluate the ability to correct eyesight defects through use of corrective eyeglasses. Although the test group of 40 was selected from those considered most highly motivated (midshipmen wanting to fly) the actual use of

the glasses was disappointing--about 25% continued use. The reasons seem associated with advice from "friends," and in some cases physiological reactions, e.g., headaches. Further discussion and evaluation will be needed to determine if this program should continue. The big question has to do with compliance on a volunteer program, yet the nature of studies with human beings require that only volunteer programs be pursued.

## Determining Applicability of USNA Leadership Instruction To Real World Fleet Operations

Researcher: Professor Karel Montor

Applicability of principles taught and reinforced in both the Plebe (NL102) and Second Class (NL303) leadership courses was studied as they apply on a ship of the fleet, in this case the USS MOBILE BAY (CG53). With the cooperation of the commanding officer (Captain Frank Whalen, USN) and the crew, over a period of two weeks during the hours of 0600 to 2300, it was possible to confirm

that in-port and at-sea opportunities for leadership build from and are based on the principles taught at the Naval Academy. The researcher was able to determine that instructional materials also developed by "real world" personnel remain applicable to present, and probably future Naval service operations.

## Daily Testing of Homework Efforts

Researcher: Professor Karel Montor

While early in the semester overwhelming distaste for daily testing in the 2nd Class Leadership Course (NL303), was expressed by the students, by semester's end there was close to 100% agreement that it

was the only motivator for studying, that they learned a great deal in the course, and highly recommended the practice continue.

# Research Course Projects

## Correlations Between Coronary-Prone (Type A) Behavior Pattern, Hostility, and Lipids During The Four Years at the Naval Academy

Researcher: Midshipman 2/C George S. Capen, USN

Adviser: Associate Professor Eric D. Bowman

Type A behavior, hostility, serum total cholesterol, and low-density lipoproteins have all been assessed as having relationships to coronary heart disease (CHD). Selected midshipmen at the Naval Academy were assessed to determine if they exhibited any or all of these precursors for CHD. The researcher randomly selected 122 subjects to participate in this research. The Krantz modification of the Jenkins Activity Survey (JAS) was used to assess Type A behavior; the Cook-Medley Hostility scale was used to determine hostility level; and a fasting blood sample was used for the lipid profile.

Findings indicate a significant relationship between Type A behavior and hostility. A weak relationship was also found between Type A's and Type B's (inverse relationship), and all of the lipids when they were divided into high or low hostility groups. The Naval Academy environment seems to have an effect on Type A development. However, unexpectedly high scores were found and the validity of the JAS for this environment is questionable.

## Personality Differences Between Selected Athletic Teams

Researcher: Midshipman 1/C Brent M. Cornell, USN

Adviser: Associate Professor Eric D. Bowman

Longstanding perceptions that specific personalities go hand-in-hand with sports and their athletes is a topic that has raised a great deal of controversy. The present study was undertaken to determine whether personality differences exist in male varsity athletes of different sports at the Naval Academy. Subjects consisted of 52 male freshmen between the ages of 17 and 21.

Analyses of variance showed no differences in personality trends among athletes of different

sports. To establish more accurate data, profile examinations could be administered to sport teams at the Academy, as well as their service academy counterparts, and additional personality inventories could be incorporated for analysis. With more intense research and a broader array of assessment scales, more significant results may be found.

## Publications

BOWMAN, Eric D., Associate Professor, co-author, "Running Versus Weight Lifting in the Treatment of Depression," *Journal of Clinical and Consulting Psychology*, 55 (1987), 748-754.

The authors compared the effectiveness of an aerobic and nonaerobic exercise in the treatment of clinical depression in women. A total of 40 women were screened on the Research Diagnostic Criteria for major or minor depressive disorder, (non-aerobic), or wait-list control condition. Subjects were reassessed at mid- and post-treatment, and at one, seven, and 12-month follow-ups. Depression

was monitored by the Beck Depression Inventory, Lubin's Depression Adjective Check List, and the Hamilton Rating Scale for Depression; fitness level was assessed using submaximal treadmill testing. Results were remarkably consistent across measures, with both exercise conditions significantly reducing depression compared with the wait-list control condition, and generally appearing indistinguishable from each other. No significant between-group fitness changes were noted. These findings indicate that both types of exercise conditions significantly reduce depression and that these results are not dependent on achieving an aerobic effect.



## Presentations

ATWATER, Leanne E., Assistant Professor, "A Day in the Life of a Typical Midshipman at the United States Naval Academy," Psychology in the

DOD Symposium, Colorado Springs, Colorado, 14 April 1988.





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Division of  
U.S. and International Studies





DEPARTMENT OF

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# Economics

Professor J. Eric Fredland  
Chairman

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Members of the Economics Department were actively involved in research during 1987-1988. Of particular note were the efforts of Associate Professor F. Reed Johnson, whose work on risk assessment resulted in six publications in the past year. The department was enriched by the continued presence of Dr. Oliver R. Grawe of the Federal Trade Commission, who remained in the Acquisition, Supply and Logistics Research Chair sponsored by the Naval Supply Systems Command for a second year, and by Dr. Robert M. Marsh, Professor of Sociology at Brown University, who was appointed to the Manpower, Personnel, and Training Research Chair, sponsored by the Deputy Chief of Naval Operations (Manpower, Personnel, and Training). Both visiting professors completed projects for their sponsoring agencies, as well as pursuing independent research efforts. Professor Little, in collaboration with others both inside and outside the Department, worked on a number of defense-related topics, and presented results at several conferences. Work by other faculty reflects a very broad range of interests, including, among other topics, the Federal Reserve payments mechanism, the fleet performance of Naval Academy graduates, accounting systems, rural development in third world countries, and the historical development of the "Chicago School" of Economics. The first graduates of the new Honors Program in Economics, Midshipmen Marchese, VanEtten, and Wyatt, produced particularly high quality student research papers, which are abstracted below. All three were presented in seminars to the faculty.



# Sponsored Research

## Modelling USNA Graduates Performance in School and in The Fleet

Researcher: Associate Professor William R. Bowman

Sponsor: Chief of Naval Research (OP-01)

The project, begun last year, is composed of two separate parts. The first is designed to model Academy attrition and academic performance based upon known information of accepted applicants prior to their enrollment at the Academy. The second part models junior officer fleet performance based upon information of graduates during their four-year Academy experience.

Findings from the first part indicate the relative importance of SAT scores, high school class rank, extra-curricular activities, and other selected variables to the propensity of accepted applicants to attrit during plebe year and prior to graduation. These explanatory variables are also used to explain

academic and military performance of graduates (of Classes 1976-1980). The order of relative importance for most measured attrition/performance outcomes is SAT (math more than verbal), class rank, and low math/English recommendation scores. Few, if any, academic performance measures are found to have a statistically significant relation with fleet performance or attrition at the five-year-point for surface-and submarine-qualified officers. Military performance grades, given by company officers, were found to be significantly related to fleet performance--as measured by the likelihood of a junior officer being recommended for early promotion.

## Price Flexibility and Output Effects of Money Supply Changes: Some Quantitative Estimates

Researcher: Assistant Professor Hareesh M. Dhawale

Sponsor: Naval Academy Instructional Development Advisory Committee

Two kinds of small scale macromodels were estimated using quarterly data on the U.S. economy for the period 1959:1 - 1985:4. The first type of model estimated was a flexible price model under rational expectations. The second type of model estimated was a gradual price adjustment model under the assumption that expectations regarding inflation were rational.

The estimates of the flexible price model were used to test some of the key propositions of the new classical theory. In particular, in a flexible price model where expectations of inflation are rationally formed, real output is influenced only by the unanticipated changes in the money supply. This hypothesis was tested by including a measure of the unanticipated change in the money supply, as well as a measure of the anticipated change in the money supply in the output equation. The estimates of the output equation implied that the anticipated change in the money supply was statistically insignificant, whereas the unanticipated change in the money supply was statistically significant. This is in accord with the Rational Expectations Hypothesis in a flexible price setting.

Another implication of the new classical theory is that output deviations from the full employment value are positively related to unanticipated inflation. This hypothesis did not receive support from the data since the coefficient on unanticipated inflation, although positive, was not significant at the conventional 5% level.

The flexible price macromodel that was estimated was used in FE312, Macroeconomics, for generating static and dynamic forecasts of some key macroeconomic variables like real GNP, the Price level, interest rates, etc. In addition, the estimated model was used to obtain historical simulations of the 1980 and 1981-1982 recessions in order to assess the ability of a flexible price macromodel with rational expectations to track these downturns in economic activity. The simulation results suggest that the flexible price macromodel is not able to account for the severity of the 1981-1982 recession. The midshipmen received hands-on experience with a "state-of-the-art" macromodel in performing both forecasts and simulations.

## Learning Curve Estimation in Automated Clearing House Services

Researchers: Professor Rae Jean B. Goodman  
and Associate Professor Thomas A. Zak  
Sponsor: Naval Academy Research Council (OMN)

The Federal Reserve System (FED) has been involved in the payments mechanism since the creation of the System in 1914. In order to eliminate non-par banking, the Federal Reserve entered the payments system by providing check clearing and wire transfer services; automated clearinghouses were a development of the 1970's. The automated clearinghouse function developed slowly during the 1970's, but is becoming a growing method of funds transfer. Involvement in the payments mechanism has meant that the FED is included in this growing market. In 1979, the FED's total electronic fund transfers involved 0.2 billion images; by 1984, the number of images had risen to 0.6 billion.

The idea that the efficiency of a plant increases over time as the workers become more skilled through repetition of the job has been recognized by cost engineers for some time. "Learning by doing" was quantified initially with respect to airplane production and ship building. Further research has shown that progress curves or learning curves occur in many different situations. The earliest studies focused on the learning by doing phenomenon as an increase in labor productivity. However, Baloff has shown that the concept is not limited to labor productivity, but can also be applied to capital intensive sectors.

The objective of the research is to analyze the cost functions of the Federal Reserve System automated clearinghouse functions to investigate the existence of "learning by doing" in this process.

## Military Veterans and Their Voting on Defense Issues in The 98th Congress (1983-1984)

Researchers: Professor Roger D. Little,  
Lieutenant Commander Raymond F. Turner, USNR,  
and Professor John A. Fitzgerald (Political Science)  
Sponsor: Naval Academy Research Council (OMN)

As congressmen who served in World War II or the Korean Conflict leave the Congress, they are not being replaced in equal numbers by younger veterans. Decreasing numbers of veterans in the Congress suggest that support for pro-defense positions may diminish over the rest of the century. A database has been built that contains the personal characteristics of senators and congressmen and their recorded votes on defense-related legislation. The data clearly reveal that with the passage of time the demographic composition on the Congress with

respect to veteran versus nonveteran status of its members is bound to change. Preliminary vote analysis also reveals that there is substantial difference in the voting behavior on defense and defense-related issues between veterans and nonveterans. For example, in the 25 Senate bills selected for study, 17 actually passed. However, 21 would have passed if all senators had voted as the veterans did and only three would have passed if all senators had voted as the nonveteran members did.

## Spousal Earnings and PCS Moves

Researchers: Professor Roger D. Little and  
Visiting Professor John T. Warner  
Sponsor: Chief of Naval Research (OP-01)

The ramifications of having large numbers of the spouses of military members employed in the civilian labor market is of increasing interest and concern to the various services. The number of employed military spouses has grown both because of the increasing percentage of married military and because of the increasing percentage of women who seek paid employment. Research results indicate that annual earnings are lower for those who had a

move--approximately 20% lower. Additionally, those who have been employed for a year earn almost 3% more than those who are just beginning employment at their new location. A move to a new location after three years of employment at the old location imposes an initial earnings loss of about 8.5%. This loss of initial earnings is in addition to those lost as a result of lost employment time.

## Factors Influencing Retention Intentions in the U.S. Navy

Researcher: Visiting Professor Robert M. Marsh  
Sponsor: Chief of Naval Research (OP-01)

The retention of active duty Navy personnel is subject to cyclical pressures such that, to achieve given end strength levels, the policy goal at one time may be to increase retention; at another time, to decrease it. Success in realizing a given retention goal can be improved if the most important causes of retention intentions are known. To explain Navy enlisted personnel's decision to re-enlist and the total length of time both officers and enlisted personnel expect to remain in the Navy, this study develops a causal model in which (1) satisfaction with the military as a way of life varies as a function of one's duty history, expectations, and family status, and (2) all the foregoing variables have causal effects on retention intentions.

The model is estimated using the world-wide 1985 DoD survey of Navy officers (sample N = 3,975) and enlisted personnel (N = 17,262). Among both

officers and enlisted people, multiple regression analysis revealed that the most important causes of retention intentions are months of active duty, the highest paygrade one expects to reach before leaving the Navy, and satisfaction with the military as a way of life. All three of these variables had significant, positive effects on retention intentions, when other variables are held constant; i.e., all three increased the likelihood that one intended to re-enlist and remain longer on active duty. Among Navy officers, an additional factor is that the higher the present paygrade, the lower their satisfaction with the military life and the shorter their expected future years of service. For enlisted people, the more they believe their family would be better off if they had a civilian job, the less satisfied they are with military life and the less likely they are to intend to re-enlist.

## Can Spreadsheets Improve Accounting Instruction?

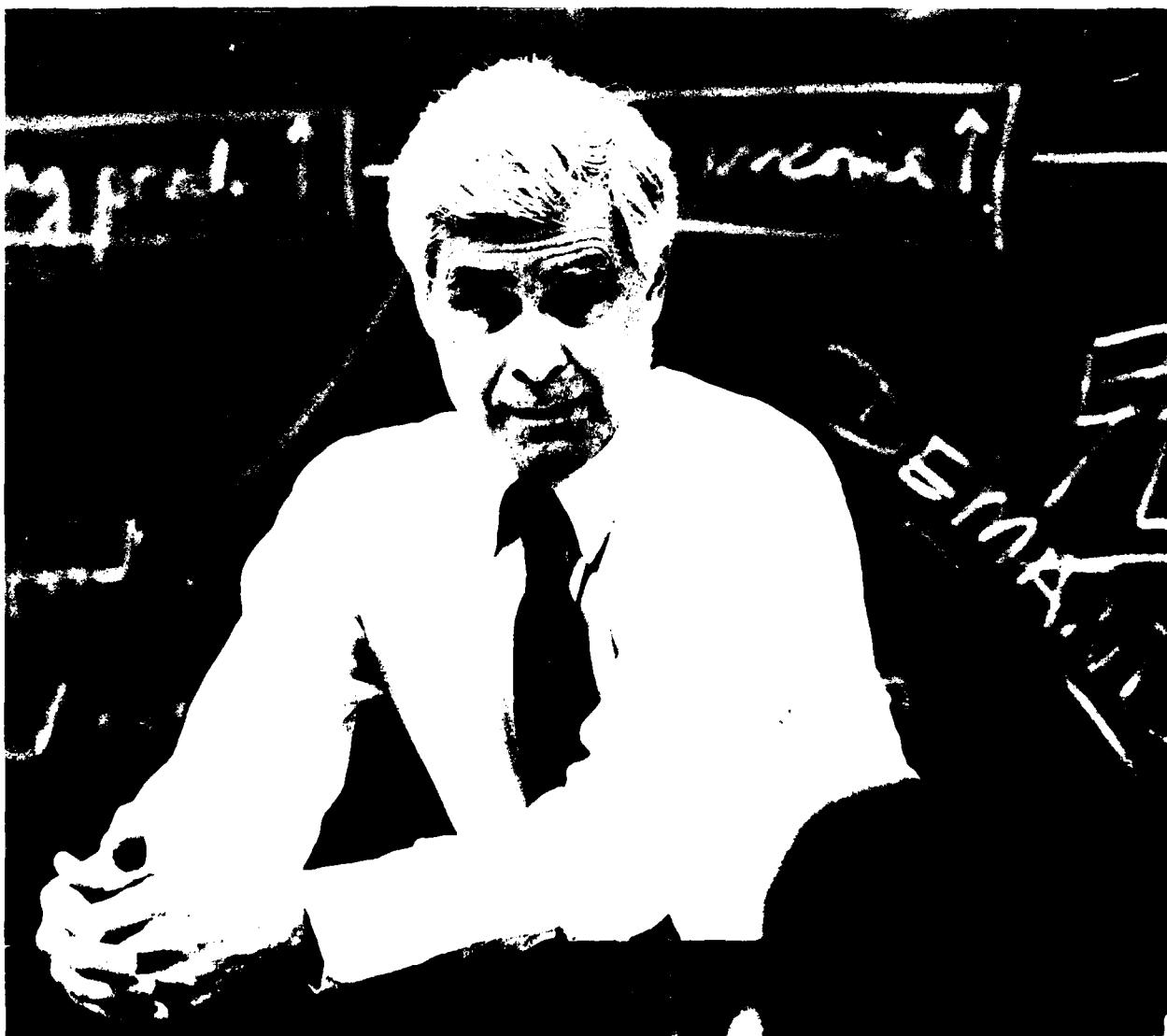
Researcher: Associate Professor A. Royall Whitaker

Sponsor: Naval Academy Instructional Development Advisory Committee

Software is available to guide even a shopkeeper who literally does not know a debit from a credit through every phase of the accounting cycle. On the assumption that the better the software is at doing bookkeeping, the less the student is learning about accounting, the first, journalizing option in this project gives careful instructions but will accept any kind of response until the entry is complete. If it is incorrect, the student is told how, and the program will not continue until it has been corrected. An initial attempt to test entries in all respects, including "cosmetics," did not work well and has to be scaled back. This was apparently successful in that, by the end of the term, all stu-

dents were doing pencil-and-paper quiz entries faultlessly.

In the belief that reasoning is required only during journalizing, posting was made completely automatic. Judged by pencil-and-paper quiz results, this was satisfactory for transactions and adjustments, but not for closing procedures. Accordingly, a more discretionary closing program has to be developed. It should be noted that whereas the principles of accounting can be illustrated with simple blackboard examples, the power of numerous roundabout techniques is obvious to many students only in the context of much larger problems.



# Independent Research

## Direct Foreign Investment as a Quota Deterrence Game

Researcher: Assistant Professor John B. Buck

Economic theory suggests that a typical motive for direct foreign investment is to avoid tariffs or quantity restrictions, yet in practice, direct investment occurs between countries without such trade restrictions. Recent evidence indicates that direct investment might not be a response to trade restrictions already in place, but instead may be an attempt to influence trade policy in the importing country. By providing benefits to the host country such as job creation and tax revenues, direct foreign investment may reduce the likelihood of trade barrier imposition. Thus, direct foreign investment may serve as a deterrent to trade barriers.

This research models the alternative view of direct foreign investment as a three-stage quota deterrence game between a home country firm, a host country firm, and the host country government. The solution of the game shows that it is possible for the home country firm to build enough productive capacity in the host country to induce the host country government either to refrain from trade restrictions or to impose smaller restrictions than what would be imposed in the absence of direct investment.

## Regional Linkage Analysis Using Social Accounting Matrices

Researcher: Associate Professor Arthur Gibb, Jr.

Agriculture-based growth is probably the key to development in the poorest of the developing nations in the 1990's. Analysis of the available policy alternatives in such contexts has been largely stymied by the inability to isolate the agricultural regions as distinct economic units within such nations. In addition, there is a index number problem in attempting to evaluate rural-urban linkages at the national level. A part of the solution to these problems is to analyze agricultural growth at the regional level using social accounting matrices, together with a structural transformation model of regional devlopment.

The structural transformation model of rural development is multi-dimensional in that it employs

data on physical output, monetary values, employment, and measures of urbanization. (It also requires data on price distortions, especially those affecting agricultural prices and foreign exchange rates.) Social accounting matrix modeling extends the standard input-output model with its emphasis on inter-industry links, making possible the estimation of average and marginal consumption propensities, labor market linkages (including migration and unemployment), geographic and sectoral sources of income, and income distribution. The first applications of this model will be to 15 key African nations for which data are relatively reliable.

## Pricing Risk in Term Reverse Mortgages

Researcher: Professor Rae Jean B. Goodman

This work, done in collaboration with Daniel Chambers of the National Association of Home Builders, involves developing a reverse mortgage pricing model based on the net present value of the stream of payments and of the home sale value. The pricing model is used to generate example payment streams and to estimate the insurance premiums for reverse mortgages. The pricing

model quantifies how (1) low equity results in low payments, (2) an increase in the length of the term of the reverse mortgage reduces the payments, (3) the interest rate and payments are inversely related, and (4) the insurance premiums on specific types of reverse mortgages are so high that no one will demand those types of reverse mortgages.

### Value of Information on Health Risks: The Case of Indoor Radon

Researcher: Professor F. Reed Johnson

Because of the nature of the radon problem and the relatively weak statutory authority to regulate indoor air pollution, the Environmental Protection Agency has decided to rely on voluntary measures to reduce radon exposures. The agency will promote voluntary mitigation by means of information programs to assist homeowners in interpreting radon test results, assessing personal health risks, and identifying cost effective house structure modifications to reduce radon concentrations. The effectiveness of such a policy depends critically on the ability of homeowners to assess risks accurately and respond rationally to the tradeoff between economic costs and increased life expectancy.

The New York Energy Research and Development Authority has tested 2500 homes for indoor radon. This program provides an opportunity to observe a

natural experiment on the formation of risk perceptions and subsequent mitigating behavior. This project will test the effectiveness of alternative information treatments in inducing correct perceptions of radon health risks and promoting appropriate mitigating responses. Observation of homeowner responses by means of a series of surveys will provide data for evaluating effectiveness and estimating the value of reduced health risks.

The first phase report has been written and published. Two manuscripts from this study are published in refereed journals, two more are in press, one is published in proceedings, and several additional manuscripts have been submitted and are under review.

The second followup survey has just been completed and will be analyzed in the coming months.

### Curriculum and Faculty Ferment at the Naval Academy 1959-1985: The Major is Still Navy

Researchers: Professor Roger D. Little  
and Professor John A. Fitzgerald (Political Science)

The post-1959 period marked the most significant change in curriculum at the Naval Academy in the 20th century--perhaps in its history. That period has been characterized as one of "revolutionary change" as the institution progressed from a curriculum common to all to a program of voluntary validation and overload electives, to an academic minors for some qualifying midshipmen, to academic majors for the entire Brigade. The substance of these changes has been chronicled before. What is original about the research is its examination of the dynamics of the process. The authors are attempting to move beyond a descriptive account of

significant change to an understanding of the forces and counterforces underlying the process. This has involved the identification of the major stimuli at work--institutional, historical, bureaucratic, political, and sociological--in order to achieve an understanding and appreciation of institutional change in a complex environment. The dynamics of these changes are in themselves inherently interesting. But more important, perhaps, is the promise of lessons that can be of use in the future, as the Naval Academy continues to be faced with the competing demands of academic education and military training.

### Screening for Moral Delinquency

Researchers: Professor Roger D. Little  
and Visiting Professor John T. Warner

The armed services all screen potential recruits mentally, physically, and morally. While the mental and physical screen have been institutionalized over the years, moral screening criteria are not uniform across the services, are relaxed and tightened in response to the supply of potential recruits, and, potentially, offer an opportunity for substantial cost avoidance and saving of recruiters' time. If satisfactory moral screening devices could be developed, recruiters' efforts could be redirected back to the primary task--that of attracting more and better recruits. Additionally, improvement in moral character predictors might allow the existing security clearance system to focus its attention on cases where the potential risk is believed to be high.

Preliminary evidence on the determinants of delinquency suggests at least two potentially fruitful areas for further research. First, there is evidence that drug use, stealing, and damaging of property can be predicted based on information that a recruiter could elicit from the applicant. Second, there is also evidence that suspension from school, which usually occurs after several instances of unacceptable behavior and associated warnings, may provide important evidence bearing on behavior that the armed forces knows to be associated with attrition.

### The Size Imperative? Longitudinal Tests

Researcher: Visiting Professor Robert M. Marsh

The theory of size as a cause of administrative intensity (the A/P ratio) is perhaps the most heavily researched topic in the study of organizations. Blau's version of this theory, like most others, is based on cross-sectional data. Using new panel data collected from 48 heterogeneous Japanese manufacturing firms in 1976 and 1983, this paper shows that prior size and complexity explain little of the variance in 1983 administrative intensity. In Japanese factories, as in U.S. school districts studied

over time by previous researchers, changes in A/P ratios in declining size organizations are not simply the *mirror image* of what happens to personnel components in growing organizations. The researcher concludes with a discussion of power versus efficiency explanations of this "ratchet effect" and with a strong appeal that causal inferences in organizations research be based more on longitudinal and panel data.

### Vignettes in the History of Economics: The Wisconsin and Chicago Schools

Researcher: Professor Clair E. Morris

In 1992 the departments of economics at the Universities of Wisconsin and Chicago will celebrate their centennial anniversary. When they opened their doors to students almost 100 years ago, there was great anticipation within the young discipline about the nature and character of the approach which each would take to the study and teaching of economics. Richard T. Ely and J. Laurence Laughlin had been rivals for the Chair at Chicago. When Laughlin was chosen, Ely accepted the Chair at Wisconsin and began an ambitious program to match and surpass whatever might be academically accomplished at the institution on the shores of Lake Michigan. The personal rivalry between Ely

and Laughlin ultimately gave rise within the profession to distinctive brands of economics known as "the Wisconsin School" and "the Chicago School."

The purpose of this research is to document more effectively the relationship that existed between these two prominent economists and to assess the lasting impact which each had on the discipline through the "schools" they founded. The letters and papers of both men will be reviewed for special insights; secondary sources are abundant and will also be explored. Currently, the project is approximately 10 percent complete with an anticipated finish date of 1991.

# Research Course Projects

## Defense Budgetary Process and Its Impact on Military Readiness

Researcher: Midshipman 2/C James D. Gonsalves, USN  
Adviser: Associate Professor William R. Bowman

The objective of the project is to determine how military readiness measures have been affected by the Reagan defense build-up during the 1980's.

Department of Defense annual budget figures are used to identify the rate of growth of spending by selected categories in terms of dollars and adjusted for inflation, and in terms of percentage composition changes over time.

The major findings of the study show that while spending for all selected categories rose significantly under the Reagan administration, the composition

of budget categories shifted away from operations and maintenance to procurement accounts. With the growing costs of new technologically complex weapons systems, and increasing budgets for their effective maintenance and operation, severe constraints are forecast on the overall readiness of our military forces in the near future. This projection will become even more constrained given expected defense budgetary cut-backs to meet Graham-Rudman ceilings imposed by Congress.

## A Federal Funds Money Market Model

Researcher: Midshipman 1/C Enrique F. Marchese, USN  
Adviser: Professor Rae Jean B. Goodman

The most liquid of all money market instruments are Federal Funds. Federal Funds are short-term loans of immediately available deposits at Federal Reserve Banks and collected liabilities of commercial banks and other depository institutions. This is an open market for loans between private financial institutions. The market engages in some degree of competition with the Federal Reserve and its willingness to loan via the discount window.

This study started with an estimation of a model developed by J. Boughton. The study was updated and ordinary least squares, two stage least squares, and three stage least squares methods were applied to the system of equations. The conclusions from the estimates of Boughton's functions tend to support his hypothesis that the Federal Funds market adds to the efficiency of policy implementation.

The Federal Reserve has experimented with multiple monetary targets since the early 1970's. More recently, it has abandoned the Federal Funds rate as its operating instrument and has adopted the nonborrowed reserve aggregate as an instrument. With such a change in operating procedure and Federal Reserve Policy objectives, a new and more descriptive model of the money market was developed. This alternative model is based on a synthesis of various money market models and considers only those relationships which provide some theoretical and empirical significance. The money supply is assumed to be responsive to the Federal Funds rate. The estimations of this model did support a money stock that is responsive to the Federal Funds rate; however, the linkages between the instrument and the target were indeterminate or inconsistent with expectations.

## Looking for the Best Deal: A Search Model

Researcher: Midshipman 1/C Kurt A. VanEtten, USN  
Adviser: Associate Professor F. Reed Johnson

The question posed in this study is, how willing is a consumer to seek out information when seeking information is costly? The methodology employed a computerized experiment in which participants were confronted with uncertainty about prevailing and future prices and an incentive system to conserve resources. Under various forms of imperfect information, the buyer, acting as a procurement officer, was able to purchase insurance against future price increases from a current supplier of hand grenades, or to search for a lower price among competitors.

Performance of each player was compared to the optimal strategy derived from a behavioral model based on perfect information. The results of the simulation show that better information enables players to learn how to search more quickly and to improve their performance. Furthermore, the results show that players without access to better information regarding the probability distribution of the return will seek out significantly more contacts in order to find out information about the probabilities of the new contacts.

## U.S.N.A. Service Selection: A Contingent Methodology Approach

Researcher: Midshipman 1/C Eric R. Wyatt, USN  
Advisers: Professor F. Reed Johnson and  
Associate Professor Thomas A. Zak

It is well understood in economics that jobs are bundles of pecuniary and nonpecuniary characteristics. Varying the bundles changes the desirability of the job and the likelihood that an individual will choose a particular job. For example, increasing monetary compensation, *ceteris paribus*, makes a given job more attractive. Conversely, expanding disamenities will reduce the probability that a particular job will be chosen. Thus, by comparing different jobs one can estimate implicit market prices for each characteristic, and determine how changes in the levels of different characteristics alter the probability that a particular job in the individual's opportunity set will be chosen.

This study applies a contingent methodology approach to estimating the relative desirability of different pecuniary and nonpecuniary characteristics in midshipmen's service selection decisions. Second class midshipmen were surveyed during the spring of 1988. They were asked to answer questions concerning personal characteristics (race, sex, etc.)

and to rank eight different combinations of job characteristics from most desirable to least desirable. The eight hypothetical combinations varied monetary compensation, length of service commitment, predictability of in-port schedule, and the selectee's choice of home-port, billet, and platform. Three different versions were administered in order to expand the range of potential choices.

Controlling for personal characteristics, an ordered logit model was estimated. The empirical results indicate (as expected) that raising monetary compensation increases the probability that a particular job will be chosen. Increasing length of service commitment reduces the probability that a job will be chosen. In addition, the magnitudes enable one to comment on the tradeoffs individuals make in service selection. This has potentially important implications for military manpower policy that will be explored in the next phase of this project.

## Publications

BOWMAN, William R., Associate Professor, "The Role of Experimental Designs in Estimating The Effectiveness of Dislocated Worker Programs," *Job Training Partnership Act Impact*, 3 (August 1988), 13-14.

The study summarizes and contrasts the major findings and statistical methodology used in three major federally funded and supported random assignment programs for Job Training Partnership Act (JTPA) Title III dislocated worker programs in the United States. The major findings in the study support the feasibility of random assignment of personnel to designed work search and retraining programs in large scale worker lay-off cases. In addition, the findings support the cost-effectiveness of job search assistance only as compared with more costly classroom and on-the-job retraining programs.

JOHNSON, F. Reed, Associate Professor, co-author, "Informed Choice or Regulated Risk? Lessons from a Study in Radon Risk Communication," *Environment*, 30, 4 (May 1988), 12-15; 30-35.

This article reports some preliminary results from a social experiment designed to test the sensitivity of people's responses to alternative presentations of the same facts about radon risks. Ethical issues enter the experiment in two ways. First, it was found that the way risk information is presented does matter and therefore involves ethical judgments. Second, ethical issues arose in the design of the social experiment itself. These concerns limited the acceptable range and character of the experiment.

Among the significant findings of this study are: different groups (for example, older people) responded differently to the same message; providing less information to low-risk individuals created undue anxiety and increased the likelihood that such people would overinvest in protective measures; despite significant differences in various tests of effectiveness, respondents found whatever information treatment they received useful, understandable, and adequate for their purposes.

JOHNSON, F. Reed, Associate Professor, "Economic Cost of Misinforming about Risks: The EDB Scare and the Media," *Risk Analysis*, 8, 1 (May 1988), 261-269.

This study reports results of an analysis of consumer responses to news reports of grain-product contamination by the pesticide ethylene dibromide (EDB). The results demonstrate that it is possible to quantify market disruption related to the dissemination of risk information. Implications include the need for increased awareness among risk managers that public perceptions, regardless of their objective accuracy, can induce real economic costs. Such costs should be considered in designing regulatory and information policies.

JOHNSON, F. Reed, Associate Professor, co-author, "How Do Risk Perceptions Respond to Information? The Case of Radon," *Review of Economics and Statistics*, 70, 1 (February 1988), 1-8.

A specialized survey of Maine households' responses to information about the risks associated with radon concentrations in their homes and water supplies was used to evaluate how they form risk perceptions. The findings support a modified form of a Bayesian learning model to describe how individuals used the information to revise their risk perceptions. Moreover, individuals who took some mitigating actions reported lower risk perceptions after that action. The overall results are potentially important to the use of information programs as policy instruments for risk reduction, because they indicate that new information can affect risk perceptions in a systematic way.

## ECONOMICS

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JOHNSON, F. Reed, Associate Professor, "Wildlife Benefits and Economic Values: Contributions of the Pittman-Robertson Program," *Restoring America's Wildlife*, ed. Harmon Kallman. U.S. Fish and Wildlife Service, 1987, pp. 219-228.

Fifty years ago the Pittman Robertson Act established the Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. Investments in this program have yielded substantial, tangible benefits to society. This chapter discusses an economic methodology for measuring nonmarket benefits of wildlife conservation and reports estimates of such values for four programs funded by the Pittman-Robertson Act.

JOHNSON, F. Reed, Associate Professor, "A Case Study in Risk Communication: EDB Contamination of Grain Products," *Proceedings of The National Conference on Risk Communication*, ed. J. Clarence Davies, Vincent T. Covello, and Frederick W. Allen. Washington, DC: The Conservation Foundation, 1987, pp. 83-86.

This chapter summarizes papers presented in a panel discussion at the National Conference on Risk Communication in January 1986. This panel addressed various issues relating to media coverage, regulatory actions, and consumer response to grain product contamination by the pesticide ethylene dibromide (EDB). The EDB episode was primarily a risk communication problem rather than a regulatory problem and highlighted the importance of integrating risk communication with regulatory decision making.

JOHNSON, F. Reed, Associate Professor, co-author, "Communicating Radon Risk Effectively: A Mid-Course Evaluation," Office of Policy Analysis, U.S. Environmental Protection Agency, Publication No. EPA2300787029, July 1987.

This report presents preliminary results of a major research project involving cooperative efforts by the U.S. Environmental Protection Agency, the New York State Energy Research and Development Authority, and the New York State Department of Health. Twenty-three hundred homes were monitored for the presence of radon and the homeowners were randomly assigned one of six information "treatments." Participants were surveyed before and after receiving the information on radon risks and mitigation alternatives. Among the findings of an extensive analysis of the survey results are: homeowners updated their perceptions of radon-related risks in a way that conforms with a Bayesian process; the treatment consisting of a single-page fact sheet created unnecessary concern and confusion and was associated with high risk perceptions of very low objective risks; older respondents had difficulty in all measures of effectiveness; and no single treatment was superior for all measures of effectiveness.

JOHNSON, F. Reed, Associate Professor, "Radon Control Policies in Sweden: A Status Report," Stockholm School of Economics, June 1987.

This report discusses the successes and failures of various radon programs in Sweden. Swedish researchers were among the first to discover that radon concentrations in private homes constitute a significant public health problem, to conduct epidemiological studies of uranium miners to quantify the link between exposure to radon and the incidence of lung cancer, and to pioneer methods of modifying existing structures to reduce radon intrusion. Nevertheless, Swedish regulatory programs have not achieved goals set five years ago to monitor all homes and to reduce maximum indoor concentrations in all homes to the recommended standard.

MARSH, Robert M., Visiting Professor, "The Changing Industrial Relations Scene in Japan and its Impact on Managerial Behavior," *Management Under Differing Labor Market and Employment Systems*, ed. G. Dlugos, W. Dorrow, and K. Weiermair. Berlin: de Gruyter, 1987, pp. 219-232.

The challenges of the oil shocks of the 1970's called for a more drastic restructuring of Japanese industry than would have been required had only general modernization processes been operating. To what extent was the "lifetime employment system" in the larger Japanese firms a constraint on managers who, faced with the severe economic recession, had to reduce their work force?

In some ways and to some extent, the adjustments made were influenced by the distinctive features of the Japanese employment system. Although the lifetime employment system's norms do impose real constraints on managers, there is also flexibility in the system. To explore this empirically, a sample of 48 heterogeneous Japanese manufacturing firms in 1976 and again in 1983 was studied. Even during the recession, some of these firms expanded their number of employees, while others were able to retrench. Regression analysis reveals that the main cause of how much the number of employees declined or expanded was not the "Japanese employment system" variables, but rather the degree of organizational slack.

It also was shown that contrary to the technological unemployment thesis, Japanese firms whose automation increased were in fact more likely than those whose technology either did not change or became less automated to increase their number of employees. The "lifetime employment" system cannot explain this, since under no interpretation does it require a firm to increase its work force.

## Presentations

BOWMAN, William R., Associate Professor, "Do Engineers Make Better Junior Officers?", Eastern Economic Association Annual Meeting, Boston, Massachusetts, 15 April 1988.

BOWMAN, William R., Associate Professor, "An Empirical Test of the Rickover Hypothesis," Naval Post Graduate School, Monterrey, California, 2 May 1988.

BUCK, John B., Assistant Professor, "Direct Foreign Investment as a Quota Deterrence Game," International Trade Workshop, University of Wisconsin, Madison, Wisconsin, 3 November 1987.

GIBB, Arthur, Jr., Associate Professor, "Excellence in General Education: The Case of Economics," Association of American Geographers Meeting, Phoenix, Arizona, 9 April 1988.

GOODMAN, Rae Jean B., Professor, "Learning Curve Estimation in the Payments Mechanism," Western International Economics Association Conference, Vancouver, Canada, 10 July 1987.

GRAWE, Oliver R., Visiting Professor, and Thomas A. ZAK, Associate Professor, "Terrorism as Political Advertising," Memphis State University, Memphis, Tennessee, 22 October 1987; Atlantic Economic Society Meetings, London, England, 19 April 1988; and Bristol Polytechnic (UK), Bristol, England, 22 April 1988.

GRAWE, Oliver R., Visiting Professor, Thomas A. ZAK, Associate Professor, and Rae Jean B. GOODMAN, Professor, "Learning Curve Estimation in the Payments Mechanism," Atlantic Economic Society Meetings, London, England, 18 April 1988.

JOHNSON, F. Reed, Associate Professor, "Results of a Field Experiment in Communicating Radon Risks," Department of Economics, University of Stockholm, Stockholm, Sweden, 10 June 1987; and Swedish Institute of Environmental Medicine, Karolinska Institute, Stockholm, Sweden, 8 June 1987.

JOHNSON, F. Reed, Associate Professor, "Conventional Wisdom on Risk Communication and Evidence from a Field Experiment," Annual Meetings of the Society for Risk Analysis, Houston, Texas, 2 November 1987.

LITTLE, Roger D., Professor, John A. FITZGERALD, Professor (Political Science), and Raymond F. TURNER, Lieutenant Commander, USNR, "Military Veterans in Congress and Their Support of National Defense and Veteran's Legislation," Inter-University Seminar on Armed Forces and Society Biennial International Conference, Rosemont, Illinois, 8-10 October 1987.

LITTLE, Roger D., Professor, and John A. FITZGERALD, Professor (Political Science), "Curriculum Evolution at Annapolis, 1960-1986: The Major is Still 'Navy,'" Inter-University Seminar on Armed Forces and Society Biennial International Conference, Rosemont, Illinois, 8-10 October 1987.

LITTLE, Roger D., Professor, co-author, "Permanent Change of Station Moves and Spousal Earnings Losses," Eastern Economic Association, Boston, Massachusetts, 10-12 March 1988.

LITTLE, Roger D., Professor, and John T. WARNER, Visiting Professor, "Screening for Moral Delinquency," Economics of Defense Manpower Conference, United States Air Force Academy, Colorado Springs, Colorado, 20-22 July 1987.

MARSH, Robert M., Visiting Professor, "Japanese Corporations," Executive Management Seminar at Prudential Life Insurance Co, Newark, New Jersey, 9 September 1987.



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# Language Studies

Professor Michael C. Halbig  
Chairman

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We made important progress in the research arena this year. After a year of getting ready, we implemented our multi-year evaluation of interactive video technology by introducing twenty-three IAV lessons for the Basic Spanish course. Department efforts to acquire a large satellite earth station also reached fruition; we broke ground for the new antenna in early spring on Hospital Point and expect completion of a "turn-key" system by December. We also completed our fifty-station interactive video lab after over a year of careful planning and design. This lab is now available to midshipmen over twelve hours a day for IAV homework.

On an individual basis, virtually everyone in the department was involved in research this year; we had the largest number of conference presentations ever. We also saw a significant number of book-length manuscripts completed or published. We're proudest of our colleague Eva Corredor, who participated in the Britannia Royal Naval College exchange and gave over eight presentations at professional conferences and colloquia in England during her stay. We were honored by the presence of Protase Woodsford, Visiting Distinguished Linguist from the Educational Testing Service, who developed key evaluation instruments for our IAV project and made significant contributions to lesson development. Midshipmen and faculty research projects and sabbaticals continue to be an important foundation for faculty research, in addition to our outside support by the National Cryptologic School.



# Sponsored Research

## Annapolis Interactive Video Project

Researchers: Assistant Professor William H. Fletcher (Project Director), Assistant Professor Christopher D. Buck, Associate Professor Sharon G. Dahlgren, Professor John A. Hutchins, Assistant Professor Enrique Márquez, Instructor María E. Castro de Moux, Associate Professor Helen E. Purkitt (Political Science), Assistant Professor Ludmila A. Z. Pruner, Professor J. Guy Riccio, Associate Professor Gladys M. Rivera-La Scala, Visiting Professor Claire St. Léon, Distinguished Visiting Linguist Protase E. Woodford, and Professor John D. Yarbro

Sponsor: Department of Defense, National Security Agency

Since its inception in 1985, this project has expanded into a team of professors who author IAV lessons for Spanish, French, and Russian, supported by a computer programmer, and has produced seven videodiscs in French, Russian, and Spanish. The Project team has also selected and equipped the language learning center with a second generation of 50 student workstations, based on the Zenith 248 microcomputer, and software written in IMSATT. A standard approach to authoring lessons has been developed, and extensive documentation has been produced to guide authors through the process: authors combine selections from a repertoire of some twenty presentation and exercise template types into a lesson structure and provide lesson content in text, graphic, and 'control' files produced with standard word processing and graphic software.

In the 1987-1988 academic year, the Project team has produced a total of 23 IAV lessons for Beginning Spanish: nine programs for FS101 and fourteen for FS102. FS101-102 was chosen as the first course to have computer-assisted language instruction integrated into the curriculum, since it offers the large student population essential for collecting statistically-reliable data for an accompanying longitudinal study of language acquisition via computerized IAV. For this study, beginning Spanish students have been divided at random into two groups, in which they remain for four semesters: a video group, which spends about 45 minutes per week of homework time on IAV lessons, and a control group, which is assigned additional work with traditional audio tapes. Student performance on specially developed listening comprehension tests keyed to standardized Educational Testing Service tests is measured and compared at entry level and after the second and fourth semesters. This study, which began in fall 1987, will continue for two cycles of students through the FS101-102-201-202 sequence, i.e., through spring 1990. The following interactive video lessons were composed and used during 1987-1988:

DAHLGREN, Sharon G., Associate Professor:

1. Paso C: "La familia"  
"La escuela"
2. Paso D: "¿De dónde es usted?"  
"Los estudiantes"
3. Capítulo 4: "Academia de policía" (with Protase Woodford)
4. Capítulo 7: "Calesero" (with Protase Woodford)  
Parte 1 y Parte 2
5. Capítulo 8: "La comida" (Parte 1) (with Guy Riccio)  
"Los restaurantes" (Parte 2)

6. Capítulo 12: "Sólo mi historia" (Parte 2)  
FLETCHER, William H., Assistant Professor:

1. Capítulo 1: "Oferta especial Uniroyal"  
"Acapulco Ritz"
2. Capítulo 5: "Urbanización Nuevo Vallarta" (with Ludmila Pruner)
3. Capítulo 10 A and B: "Puertos y fortificaciones" (with María Moux)

MARQUEZ, Enrique, Assistant Professor:

1. Capítulo 2: "Comer en Aladino's"  
"Un Horario de Cierre"
2. Capítulo 6: "Tiempos Mejores por Yuri"
3. Capítulo 9 A and B: "Montevideo"

MOUX, María Castro de, Assistant Professor:

1. Paso B: "Saludos y una Canción"
2. Capítulo 3: "Tic-Tac Musical"  
"En el Desierto"

3. Capítulo 10 A and B: "Puertos y fortificaciones" (with William Fletcher)

PRUNER, Ludmila A., Assistant Professor:

1. Paso E: "Hace buen tiempo"
2. Capítulo 4: "Tengo que cantar!"
3. Capítulo 5: "La Residencia"
4. Capítulo 12: "De compras"

RIVERA-LA SCALA, Gladys M., Associate Professor:

1. Capítulo 1: "Las profesiones"

WOODFORD, Protase, Distinguished Visiting Linguist:

1. Capítulo 4: "Una carrera con Futuro (Academia de policía)"
2. Capítulo 7 A and B: "Calesero" (with Sharon Dahlgren)

## A Different France: Documents from The Minority Cultures of France

Researcher: Assistant Professor Audrey P. Gaquin  
Sponsor: Naval Academy Research Council (OMN)

The anthology of documents from the minority cultures of France is intended to make available to scholars, teachers, and students of French civilization information about the regional cultures, including primary source materials such as interviews of minority leaders, sample lessons in the minority languages, literary works in the language, information about minority history, customs, and traditions, the current status of each minority culture, and central government policy towards the minorities.

During Summer 1987, interviews were conducted in France with the following minority leaders: M. Fernandez and M. Not of the Centre de documentation et d'animation de la culture catalane (CDACC); M. Stromboni, of Cultura di lingua corsa, J. Meyer-Freund of the Cercle René Schickelé in Alsace, J. Fermaut of the Cercle Michel de Swaen in Flanders, and P. Denez of the Section

de Celtique, Université de Haute-Bretagne. The interviews, dealing with the status of the minority language and culture and the development of French regionalism, were conducted in French and recorded on cassette, with the exception of the interview of M. Stromboni, which was conducted in writing. Source materials on minority rights in France, Catalan, Alsatian, Corsican, Flemish, and Breton language, literature, and culture were selected, and regional museums and cultural centers were visited.

The process of collecting materials and conducting interviews for the anthology is now essentially complete. Most of the selection of documents to be included in the anthology is also complete. During summer 1988, the preparation of an introductory chapter for each section will be completed, and the manuscript will be prepared for submission to a publisher.

## La Correspondencia De Luis Alberto Sanchez (The Correspondence of Luis Alberto Sanchez)

Researcher: Assistant Professor Elsa M. Gilmore  
Sponsor: Naval Academy Research Council (OMN)

The purpose of this ongoing project is to produce an edition of the previously unpublished correspondence of Luis Alberto Sánchez. Dr. Sánchez is a well known writer and scholar, and one of the founders of Peru's APRA Party. He is also Vice President of Peru. His correspondence is of interest to scholars in the fields of literature, history, and political science.

At present, this writer has transcribed approximately one-half of the letters authored by well-

known literary figures or which deal primarily with literary topics, and work continues. Additionally, the author traveled to Peru in July 1987 for the purpose of interviewing Dr. Sánchez. Dr Sánchez and his staff provided the writer with additional texts (not contained in the original Pennsylvania State University Archives being transcribed). These letters will be included in the edition.

## A Study of the Cinematic Image in Andrei Tarkovsky's "Ivan's Childhood"

Researcher: Assistant Professor Ludmila A. Pruner  
Sponsor: Naval Academy Research Council (OMN)

The purpose of this research is to analyze Andrei Tarkovsky's treatment of cinematic image in his 1962 film, "Ivan's Childhood." Andrei Tarkovsky (1932-1986), a Soviet-born film maker, began his career during the post-Stalinist era of the late 1950's-early 1960's. This ten-year period in Soviet cultural life, often called the period of de-Stalinization, allowed many young artists the freedom to experiment with new artistic forms beyond the rigid boundaries of the dogma of Socialist Realism.

The 1962 film production, "Ivan's Childhood," marks the beginning of Tarkovsky's search for new means of cinematic expression free of the influence of literature, painting, and theater. Tarkovsky believed that "the most realistic of the arts," the cinema, is able to incarnate reality directly and by its own means. Thus, he began to formulate and put in practice his concept of "the logic of poetry in cinema" based upon the poetic links of images in non-linear cinematic narrative. This analysis will focus on the intrinsic characteristics of images in Tarkovsky's early work.



# Independent Research

## Semiotics and Calderon

Researcher: Associate Professor Sharon G. Dahlgren

This book-length study combines the methodology of the semiotics of theater with historical archival research on Pedro Calderón's secular and religious drama of seventeenth-century Spain. In an attempt to develop a pragmatic model for the analysis of dramatic art, the researcher has identified two complementary semiotic levels, the microsign that takes into account sign typology as in Charles S. Peirce's icon, index, and symbol, and the macrosign that refers to larger systematic constructs responsible for plot dynamics. Adding to this model is the game theory of Thomas Pavel, which blends transformational grammar systems and dramatic action.

Areas of inquiry which this study addresses are the function of sibling relationships in Calderón as they control the dynamics of plot structure, feminine perspectives, Calderonian models for tragedy, performance codes, with analysis of specific twentieth-century productions recorded on videotape, and comparative studies with similarly structured pieces from the English stage. The objective of this study is to provide a clearer understanding of character and plot, text and performance, with a model that attempts to account for verbal and non-verbal sign systems.

## Spanish Golden Age Poetry and Drama

Researcher: Assistant Professor Rita P. Landers

The purpose of this research is twofold. On one hand, it continues the researcher's exploration of the epic poem of Barahona de Soto (*Las Lágrimas de Angelica*) in relation to its classic and Italian sources, studying the intertextual relationship between primary and secondary texts as they relate to specific topics. In addition, the research on

Spanish Golden Age, in particular that of Lope de Vega, explores how Lope's early plays incorporated themes and characters from Ariosto's and Barahona's poems. This includes the study of Lope's epic poem, *La hemiosura de Angelica* (a continuation of Barahona's), and Lope's subsequent play of the same name.

## Automated Biographic Analysis of The Chinese Military Leadership

Researcher: Professor Daniel T.Y. Lee

This is a continuing long-range research project to study biographic characteristics and career patterns of significant military leaders in the People's Republic of China. It employs English-text summaries prepared according to strict syntactical rules with embedded computer flags permitting the computer to search biographies and develop summaries by characteristics, or to link logically different

leaders as they progress through their careers. As data accumulate, it is expected that hierarchical clustering techniques will establish patterns of ascendancy.

The total number of biographies included now stands slightly over 1,000, and about 500 previous entries have been updated.

## Juan De Mena's COPLAS DE LOS SIETE PECADOS MORTALES: Second and Third Continuations: A Critical Edition and Study

Researcher: Associate Professor Gladys M. Rivera-La Scala

This book includes the first critical edition of the Second and Third continuations of the *Coplas De Los Siete Pecados Mortales*, left unfinished at Juan de Mena's death, and an intertextual analysis of the main poem and its three continuations. The first chapter contains a comparative study of the four works based on themes, imagery, meter, and rhyme. In the second chapter the author gives detailed, firsthand descriptions of the manuscripts and sixteenth century printings used in establishing the

base text and discusses the interrelationships that exist between the many versions of the works. A corrected version of the continuations in modern script follows. The next section comprises editorial, literary, and linguistic notes, and ends with a glossary of medieval Spanish terms and one of proper names. Included in this volume is an extensive bibliography of primary and secondary source materials on Spanish and European fifteenth-century didactic poetry.

## Sources of Videodisc Materials

Researcher: Visiting Professor Claire Saint-Leon

The purpose of this project was to gather data for an article for *CALICO* due in July, on what types of videodisc materials are best suited for various purposes, in the teaching of foreign languages when using a laser video disc controlled by a computer.

The data included consultations with colleagues, individually or in weekly IAV meetings, midshipmen's answers to questionnaires, readings on methodology, and personal experience.

## The Millennium of the Russian Icon

Researcher: Associate Professor Vladimir S. Tolstoy

Icons first appeared in the Middle East in the fourth century and gradually found their way to the west of Russia by the end of the tenth century, after the victory of Orthodoxy over Iconoclasm and the missionary work of Saints Cyril and Methodius among the Slavic peoples.

This paper discusses, in brief, the Russian icon from two points of view: that of art and of religion. It also attempts to show the significant role that the icon played in the life of the Russian people. This

essay also addresses the actual making of the icon: who the iconographers were and what attitudes they brought to their work; how to decipher the message of an icon; the relation between icons and architecture; the different schools of iconography; the Church's doctrine concerning the icon (veneratio et non adoratio); the use of the icon in the liturgy and at home; and finally, its importance to the individual Orthodox believer.

## Publications

CORREDOR, Eva L., Associate Professor, *György Lukács and the Literary Pretext*. New York and Bern: Peter Lang, 1987.

An introduction to those works of György Lukács that have established him as a classic authority in literary criticism: his pre-Marxist *The History of the Evolution of Modern Drama* (1911), still not available in English, which Professor Corredor analyzes in the original Hungarian text and from which she provides extensive quotations in English; his collection of Kantian essays, *Soul and Form* (1910); the Hegelian *Theory of the Novel* (1920); and his first Marxist work, *History and Class Consciousness* (1923), which best characterizes the Hungarian philosopher's problematic position between East and West. Lukács' Marxist theories are studied in the texts written during his exile in Stalinist Russia but published much later: *Studies in European Realism* (1950), *The Historical Novel* (1955), and *Realism in our Time* (1957). Professor Corredor's approach to Lukács' work is both selective and global. On the one hand she chooses to introduce Lukács' literary theories with a focus on his views of French literature. On the other hand, however, she integrates these theories in the totality of Lukács' intellectual development. At each phase, the true motive of Lukács' interest in literature presents itself as a pretext to the study of reality.

FLETCHER, William H., Assistant Professor, "Some Current IAV CALI Projects in Europe," *CALICO Journal*, 5, 2 (2 May 1987), 65-70.

In this article the author reports on some of his recent contacts with European researchers producing videodisc imageware and courseware of interest for interactive video-based, computer-assisted instruction for languages other than English. The major issues of video (PAL/NTSC) and computer (MS-DOS and other operating sys-

tems) (in)compatibility are discussed. The article then surveys specific sources for foreign language videodiscs, software, and information. While there is some very interesting courseware in development in Europe, the author concludes that the market does not yet warrant purchase of special equipment to play PAL-standard videodiscs.

GAQUIN, Audrey, Assistant Professor, "Review of *Studia Occitanica*, Volume I," *Tenso*, 3, 1 (Autumn 1987), 29-37.

This essay reviews a collection of thirty-three articles concerning medieval Provençal lyric dedicated to the late Paul Rémy of the University of Ghent. The articles range from studies of the sincerity *topos*, seasonal *topos*, and of *canso* esthetics, based on Guiette's analysis of the troubadour lyric as essentially formal poetry, to studies of historic and folkloric elements of troubadour poetry, and even of medieval bird-lore. The review includes an introduction to the current state of Provençal studies, a separate, detailed treatment of each article, and a general evaluation of the volume's contribution to the field.

HALBIG, Michael C., Professor, *The Jesuit Theater of Jacob Masen*. New York: Peter Lang, 1987.

In the tradition of the Jesuit school theater, Jacob Masen (1606-1681) has long had a reputation as a playwright second only to his countryman Jacob Bidermann. With no modern edition of his plays, and translations of the Latin original extremely limited, few readers have had direct access to Masen's theater. This translation and introduction were prepared to overcome this state of affairs. It presents in modern English three exemplary Masen plays—*Androphilus*, *Maurice*, and *Rusticus Imperans*. A brief introduction places the plays within the context of Masen's life and century, and his theoretical writings on the theater. The book is the only English translation of Masen's plays.

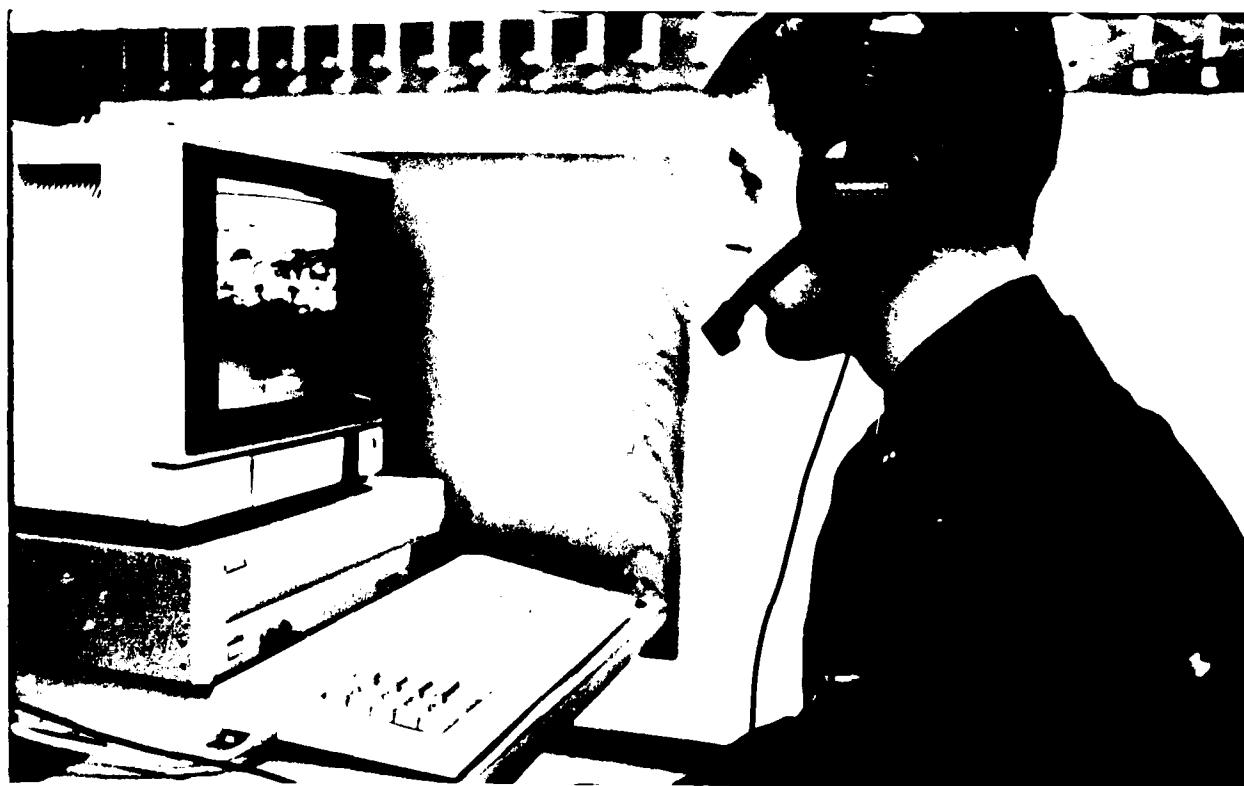
## LANGUAGE STUDIES

LANDERS, Rita P., Assistant Professor, "Dialectica neoplatonica entre amante y amado en 'Las lagrimas de Angelica' de Barahona de Soto," *Quaderni Ibero-American*, 61-62 (February 1988), 161-185.

This study focuses on the theory of love in *Las lagrimas de Angelica*, a sixteenth-century epic poem by the Spanish poet, Luis Barahona de Soto. The poem incorporates the ideas of love accepted in his time--corresponding to the Petrarchist neoplatonic theory--expanding it with a personal concern to dignify it and make it conform to the morals of the day. The three levels of love admitted by Renaissance theorists--as expressed in Leon Hebreo's *Dialoghi d'amore*--are: (1) sensual love, (2) courtly and petrarchist love, and (3) conjugal love. These three levels are exemplified in the main characters of the poem. It is in the Orco (the classical one-eyed monster, Polyphemus), Angelica, and Medoro that the ideas of love find their most prosperous development. The love of the Orco, who is transformed from man-eating monster to courtier, is directed toward the poem's heroine, Angelica. She is in love with and loved by Medoro. The relationships among the three characters perfectly follow and exemplify what Hebreo had stated in his dialogues; namely, that the lover-loved relationship is an inferior-superior one, where the loved one is the recipient and the lover is the agent of the "service of love."

RIVERA-LA SCALA, Gladys M., Associate Professor, "The Annapolis Interactive Video Project," *Modern Technology in Foreign Language Education: Applications and Projects*. Ed. William Flint Smith. Lincolnwood, Illinois: NTC Publishing Co., 1988, pp. 257-263.

This article focuses on the work done during the 1986-1987 academic year on the Annapolis Interactive Video Project, which includes: (1) designing and developing new prototypes of interactive video (IAV) programs to enhance the learning of foreign languages at the beginning and intermediate levels, using videodiscs and the computer; (2) incorporating these programs into existing curricula; and (3) creating a research design and establishing a viable plan for evaluating the effectiveness of this new approach to language acquisition. In the fall of 1987, from seventy to eighty students in first-year Spanish courses began using IAV lessons to practice listening comprehension and, to a lesser extent, reading comprehension skills. These programs gave them the opportunity to acquire and reinforce these skills through controlled exposure to native-speed materials provided by foreign language television programs.



# Presentations

CORREDOR, Eva L., Associate Professor, "György Lukacs' Critical Methodology," Postgraduate Staff Seminar, Departments of French and English, University of Leeds, Leeds, United Kingdom, 15 December 1987.

CORREDOR, Eva L., Associate Professor, Panels on Beckett and Adorno, Lawrence, and Nietzsche, British Comparative Literature Association, Collingwood College, University of Durham, Durham, England, 16-17 December 1987.

CORREDOR, Eva L., Associate Professor, "György Lukacs' Critical Methodology," Faculty of Arts, Queen Mary College, University of London, London, England, 22 February 1988.

CORREDOR, Eva L., Associate Professor, "From Lukacs to Posthistoricism," University of Essex, Colchester, Essex, England, 23 February 1988.

CORREDOR, Eva L., Associate Professor, Chair, Plenary Session, "Literary History and the History of Philosophy," Fourth Annual Conference of the British Society for the History of Philosophy, University of Edinburgh, Scotland, United Kingdom, 7-9 April 1988.

CORREDOR, Eva L., Associate Professor, "György Lukacs' Historicist Methodology", Department of French, University of Edinburgh, Scotland, United Kingdom, 25 April 1988.

CORREDOR, Eva L., Associate Professor, "War and Revolution in György Lukacs' *Theory of the Novel*," College Seminar, Sidney Sussex, Cambridge University, Cambridge, England, 27 April 1988.

DAHLGREN, Sharon G., Associate Professor, "Thomas Kyd and Pedro Calderón: Towards a Semiotics of Revenge Drama," Parallel Lives: An International Interdisciplinary Conference on Spanish and English National Drama, 1580-1680, University of Calgary, Calgary, Alberta, Canada, 14-18 October 1987.

DAHLGREN, Sharon G., Associate Professor, Moderator, Plenary Session on "Visión sincrética de la tragedia del Siglo de Oro Español," Eighth Annual Golden Age Spanish Drama Symposium, University of Texas, El Paso, Texas, 12 March 1988.

FLETCHER, William H., Assistant Professor, Chair and Organizer, "From Investigation to Instruction: Linguistics for Learning Dutch," Interdisciplinary

Conference on Netherlandic Studies, Minneapolis, Minnesota, 15-18 June 1988.

FLETCHER, William H., Assistant Professor, "The Annapolis Interactive Video Project: Insights and New Directions," Computer-Assisted Language Learning and Instructional Consortium (CALICO), Salt Lake City, Utah, 25-27 February 1988.

FLETCHER, William H., Assistant Professor, "Integrating Interactive Video in the Curriculum: the Annapolis Interactive Video Project," Symposium on Enhancing Higher Education through Microcomputers, Washington, DC, 11-12 November 1987.

FLETCHER, William H., Assistant Professor, "A Longitudinal Study of Satellite Video in the Classroom: The Annapolis Interactive Video Project," Computer-Assisted Language Learning and Instructional Consortium (CALICO) Symposium, Paris, France, 18-21 September 1987.

FLETCHER, William H., Assistant Professor, "Interactive Video at the United States Naval Academy," Institute for the Transfer of Technology to Education (ITTE) Network Conference, Annapolis, Maryland, 22 June 1987.

GILMORE, Elsa M., Assistant Professor, "Narrative Time in César Vallejo's 'Hymn to the Republican Volunteers'," Kentucky Foreign Language Conference, Lexington, Kentucky, 23 April 1988.

GILMORE, Elsa M., Organizer, Special Session on César Vallejo, Kentucky Foreign Language Conference, Lexington, Kentucky, 23 April 1988.

GILMORE, Elsa M., Assistant Professor, "Myth and its Subversion in *The Night of the Assassins*, by José Triana," Dartmouth Latin American Theatre Conference, Hanover, New Hampshire, 10 October 1987.

GILMORE, Elsa M., Assistant Professor, "Space in the Theatre of Egon Wolff," International Conference on Latin American Theatre, Paris, France, 18 May 1988.

LANDERS, Rita P., Assistant Professor, "Imitación creadora y creatividad imitadora en el *Orcio de Barahona*: un eslabón significativo en el tratamiento de un mito clásico favorecido," The Thirty-seventh Annual Mountain Interstate Foreign Language Conference, Richmond, Virginia, 8 October 1987.

## LANGUAGE STUDIES

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LANDERS, Rita P., Assistant Professor, "Imitacion y creacion en dos comedias de Lope de Vega ('Los celos de Rodamonte' y 'Angelica en el Catay')," Golden Age Spanish Drama Symposium, The University of Texas, El Paso, Texas, 10 March 1988.

MARQUEZ, Enrique, Assistant Professor, "The Problem of Tyranny: A Xenophobic Analysis of Sarmiento's *Facundo*," The Thirty-seventh Annual Interstate Mountain Conference, University of Richmond, Richmond, Virginia, 10 October 1987.

MARQUEZ, Enrique, Assistant Professor, Chair, Panel on "Drama, Society, and the Individual," Kentucky Foreign Language Conference, University of Kentucky, Lexington, Kentucky, 21 April 1988.

MOUX, María E. Castro de, Assistant Professor, "Fuenteovejuna: Honor y Revolucion. Conceptos aristotélicos en Lope de Vega," Golden Age Spanish Drama Symposium, University of Texas, El Paso, Texas, 9 March 1988.

PRUNER, Ludmila A., Assistant Professor, "Sculpting in Time: Cinematic Image in Works by A. Tarkovsky," Annual Convention of the American Association for the Advancement of Slavic Studies (AAASS), Boston, Massachusetts, 6 November 1987.

PRUNER, Ludmila A., Assistant Professor, "Return to Soviet Cinema: Unbanned Works by Kira Mura-

tova," Annual Convention of the American Association of Teachers of Slavic and East European Languages (AATSEEL), San Francisco, California, 28 December 1987.

SAINT-LEON, Claire B., Professor, "Sources of Videodisc Materials and Criteria for their Evaluation," Calico '88, Salt Lake City, Utah, 26 February 1988.

SAINT-LEON, Claire B., Professor, co-author, "Interactions Audio-Visuelles, An Interactive Video Application for the French Classroom," Computer-Assisted Language Learning and Instructional Consortium (CALICO) Symposium, Salt Lake City, Utah, 27 February 1988.

SAINT-LEON, Claire B., Professor, co-author, "Video Materials from Satellites: Fostering Listening, Cultural, and Speaking Proficiencies," Northeast Conference on the Teaching of Foreign Languages, New York, New York, 7 April 1988.

SAINT-LEON, Claire B., Professor, co-author, "Interactions Audio-Visuelles, un disque laser pour l'enseignement par l'image et le son. A Laser Disc to Teach Contextual French," South Central Organization of Language Teachers, Central States Annual Meeting, Denver, Colorado, 15 April 1988.

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# Political Science

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Professor Charles L. Cochran  
Chairman

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There was a significant increase in research and publication during the past year within the Department of Political Science. Department members received more competitively awarded grants based upon research design, relevance, and the likelihood of successfully completing the proposed project than in any previous year. Professor Atkins completed an updating and revision of a book he previously published which is to be printed as a revised later edition. Professor Atkins was also the recipient of a study grant to attend the International Summer Course on International Security, Institute of Political Science, Christian-Albrechts University, Kiel, Germany. Professor Frantzich completed a manuscript on **POLITICAL PARTIES IN THE TECHNOLOGICAL AGE** which will be published by Longman Publishers in July.

There was significant research in areas of pressing governmental interest, in which faculty members from the department were sought out because of their standing within the academic community. Professor Frantzich completed a study sponsored by the Office of Technology Assessment on **PUBLIC ACCESS TO EXECUTIVE BRANCH INFORMATION IN THE AGE OF TECHNOLOGY**. And Professor Cochran completed a study sponsored by the National Aeronautical and Space Administration (NASA) entitled **MOBILE SATELLITE SERVICE AND MOB-87: U.S. RESERVATIONS**, which analyzed the legal and policy alternatives of the United States in the area of satellite communications. Both of these studies have become a part of the record of the Congress.

There were four funded research projects during the year and thirteen independent (nonsunded) research projects that resulted in two books, two



Congressional Hearing inclusions, three chapters in books, ten articles in scholarly journals, and several ongoing research projects. There were at least twenty-five papers presented.

Faculty/Midshipmen Research Project activity continued to increase, with twenty-seven projects completed by midshipmen. Midshipmen also attended conferences at both West Point and at Colorado Springs.

## Sponsored Research

### The US-USSR Arms Control Negotiations: Implications for NATO Strategy

Researcher: Associate Professor Gale A. Mattox

Sponsor: Naval Academy Research Council (OMN)

Since 1969 the United States and the Soviet Union have been engaged in bilateral nuclear arms negotiations. Their discussions have assumed increasing importance for the European allies. While the allies supported the ratification of the INF Treaty and the Washington/Moscow summits as necessary steps in the arms control process, there was more than a little concern over the potentially broader implications for the future of NATO.

The objective of the NARC research was to examine several central issues confronting the United States and its allies in the ongoing arms

talks which can be expected to challenge existing alliance institutions or even fundamental assumptions with respect to NATO strategy. Is there a need to alter the decision-making process within NATO? Will the Europeans begin to move more seriously in the direction of an independent security policy? What will this mean for the United States? If SDI portends the demise of nuclear weapons globally and the "Reykjavik vision" of a nonnuclear world becomes reality, what will be the implications for a NATO strategy based in the final analysis on the concept of nuclear deterrence?

### Politburo Simulation

Researcher: Associate Professor Arthur R. Rachwald

Sponsor: Naval Academy Instructional Development Advisory Committee

This computer simulation of the decision-making process of the Soviet Politburo is designed to help midshipmen understand the complexities of the Soviet system. The student plays the role of General Secretary Gorbachev. At the pre-meeting stage the midshipman is offered to buy information. The second stage involves negotiations with other

members of the Politburo. At the third pre-vote bargaining stage, the midshipman is able to make promises on an individual basis to increase the likelihood of approval for Mr. Gorbachev's proposal. Finally, the computer calculates the vote and announces the acceptance or rejection of the proposal.

### Melding International Relations Simulations and Micro-Computers

Researcher: Professor Robert L. Rau

Sponsor: Naval Academy Instructional Development Advisory Committee

The intent of this project was to convert selected teaching materials used in FP210 (International Relations), FP 371 (Asian International Politics), and FP368 (Comparative Asian Politics) into micro format. Recognizing the importance of producing materials and exercises to be used by midshipmen in the course, research exercises requiring their use of the computer facilities, the researcher devised the following exercise:

Using Legi-Slate, a superb on-line database, the following research sources were available: hard

copies of stories in the *Washington Post*, description of any legislation; full texts of legislation; and daily press briefings.

Research exercises required the accessing of Legi-Slate, surveying *Washington Post* for pertinent stories, press briefings and legislative progress reports. Tracing trends, intractable problems, or deteriorating relations with other countries was required. Each exercise was constructed for each midshipman according to his/her topic. All students used Legi-Slate to some extent.

## Computer Support of Instruction in Political Science Course in Research Methods (FP220)

Researcher: Professor Rodney G. Tomlinson

Sponsor: Naval Academy Instructional Development Advisory Committee

The objective of this project was development of a family of micro-computer research support programs keyed to the needs of midshipmen enrolled in FP220. These needs included: (1) minimum (or no) cost for software; (2) direct application to the textbook and course curricula; (3) support of all basic (undergraduate level) independent research demands placed on them in FP220 or other Political Science Department courses; and (4) full compatibility with standard midshipmen hardware and software facilities. A (midshipman) Standard Data Structure (MSDS) was designed first, followed by a group of support programs for processing the data

entered into the structure by means of any text editor that creates American Standard Code for Information Interchange (ASCII) data files. Support programs included a generalized cross-tabulator with variable select, control, and aggregation, measures of association at all scaling levels and multiple and partial correlation. A simple exponential smoothing model was developed to introduce basic modeling techniques. The software is sufficiently compact to fit along with relevant data on a single 360k floppy diskette, thereby permitting preparation of "topic specific" diskettes for take home drill and practice.



# Independent Research

## Latin America in The International Political System

Researcher: Professor G. Pope Atkins

This book is an updated and revised version of the first edition published in 1977. The manuscript has been delivered to the publisher and is scheduled for release in October 1988. The discussion is organized around the idea of the Latin American region as a separate subsystem within the global international political system, with special emphasis given to the subregions of Mexico, the Circum-Caribbean, Brazil, and the Southern Cone. Within this frame-

work, analysis focuses on the foreign policies of the Latin American states themselves (in comparison) and on the policies of outside states and nonstate actors toward Latin America, as well as Latin American participation in international institutions, the international distribution of power and influence among the actors, and cooperative and conflictual interactions in the political, cultural, economic, and military arenas.

## Interactive Video Disc Training: Literacy and Skills Instruction

Researcher: Assistant Professor Robert L. Beckman

This project, now in its second year of development, should result in an interactive video disc (IVD) prototype for use in the Department of Defense and private industry to teach skills and literacy simultaneously. The object of the research is to combine skills and literacy training in an IVD package in order to enhance productivity through cost savings (reduced time to train; reduced travel and per diem; etc.), enhanced user retention, re-

duced errors, faster cross-training, and improved instructor usefulness. One area of skills training already under exploration is maintenance; the literacy portion of the training is undergoing evaluation. One facet of the research was a comprehensive overview of the current work which resulted in an essay: "Train Smart: Interactive Partnerships."

## Mobile Satellite Service and MOB-87: U.S. Reservations

Researcher: Professor Charles L. Cochran

The International Telecommunication Union (ITU) Conference, known as the 1987 MOBILE WARC, was held under the auspices of the United Nations to coordinate the world's electromagnetic spectrum and determine standards in international telecommunications.

The Conference agenda focused on mobile communications between mobile stations and land stations throughout the frequency spectrum. Despite preparations by the American delegation that began over three years before the Conference, the U.S. was increasingly at loggerheads with a number of individual nations, as well as with regional groupings of states, some of which have a formal basis for seeking a uniform position at such conferences. The United States ultimately appended a very complex reservation to the treaty.

The purpose of this paper was to analyze the reservation to determine whether it would achieve the goals desired by the U.S. negotiators. There was also concern that the treaty reservation was rendered null and void as a result of other treaty obligations by the participants. The final purpose was to prepare the major points of analysis to be presented in Senate testimony concerning whether or not the consent of the U.S. Senate would be forthcoming for ratification.

This paper and its analysis have become part of the public record of the Senate Hearings.

This research was sponsored by National Aeronautical Space Administration (NASA).

## Curriculum and Faculty Ferment at The Naval Academy 1959-1965: The Major is Still Navy

Researchers: Professor John A. Fitzgerald and  
Professor Roger D. Little (Economics Department)

The post-1959 period marked the most significant change in curriculum at the Naval Academy in the twentieth century. That period has been characterized as one of "revolutionary change," as the institution progressed from a curriculum common to all to a program of voluntary validation - overload - electives, to academic minors for some qualifying midshipmen, to academic majors for the entire Brigade. The substance of these changes has been chronicled before. What is original about this research is its examination of the dynamics of the process. The authors attempt to move beyond a descriptive account of significant change to an

understanding of the forces and counterforces underlying the process. This has involved the identification of the major stimuli at work--institutional, historical, bureaucratic, political, and sociological--in order to achieve an understanding and appreciation of institutional change in a complex environment. The dynamics of these changes are in themselves inherently interesting, but more important, perhaps, is the promise of lessons that can be of use in the future as the Naval Academy continues to be faced with the competing demands of Athens and Sparta.

## Public Access to Executive Branch Information in The Age of Technology

Researcher: Professor Stephen E. Frantzich

The U.S. government has long prided itself on open public access to a wide range of government information. As an increasing percentage of government information is collected and used in electronic form, both opportunities for public access and challenges to access are likely to increase. This study is part of a continuing analysis of public access issues in the technological age. It is based on over 50 interviews and extensive documentary research. This portion of the research outlines the general considerations concerning public access to electronic records and includes four detailed case studies of a range of

government agencies (The Patent and Trademark Office, The Office of the Federal Register, The U.S. Navy Printing and Publications Service, and the U.S. Department of Agriculture). Each case study focuses on current methods of sharing information with the public and methods by which new technologies are being used to enhance or thwart access. The material for this study has become part of an official report by the Office of Technology and will serve as the basis for congressional hearings during the next Congress.

## Comparative Legislative Automation Analysis

Researcher: Professor Stephen E. Frantzich

Legislatures around the world are increasingly turning to a new information technology to better perform both their legislative and political tasks. In order to analyze this phenomenon in an organized manner, a cooperative framework for analysis was created, combining the experiences of the U.S. Congress and the German Bundestag. A two month grant for on-site consultation and interviewing with German counterparts allowed the initial development. After creating the general framework for analysis, the organizational, social, and political

consequences for the two legislative chambers were outlined. After completing the comparative analysis of these two legislatures, it is hoped that the established framework can be applied to other legislative bodies. The analytical framework has been completed and the material on the U.S. Congress inserted. Work continues on completing the material from the Bundestag through a cooperative arrangement with two German scholars. This research was sponsored by GMD Research Institute.

## Political Parties in The Technological Age

Researcher: Professor Stephen E. Frantzich

This book-length manuscript (to be published in July) analyzes the current status and the future of American political parties as they attempt to come to grips with the changes brought on by the new technologies of politics. It argues that while new technologies originally served as a significant challenge to the parties, thoughtful harnessing of

new technologies by the parties could serve as the basis for their revitalization. Research for this project included visits to over 25 state parties, extensive documentary analysis, and close to one-hundred interviews. This research was sponsored by Longman Publishers.

## Victims of The State: Genocides, Politicides, and Group Repression Since 1945

Researcher: Assistant Professor Barbara Harff

This paper is concerned with the collective victimization of ethnic, religious, national, and political groups by the state. It analyzes information on more than 60 communal and political groups which have been victimized in genocides and politicides since 1945, and about 75 communal and regional groups which in the mid-1980's were the subjects of

systematic political repression or discrimination. The prospects that the latter groups will be the victims of future geno/politicides are assessed. The uses of these datasets for future research on the causes of geno/policide are assessed in the conclusion.

## Toward Empirical Theory of Genocides and Politicides: Identification and Measurement of Cases Since 1945

Researcher: Assistant Professor Barbara Harff

This paper reports on a global survey of cases of massive state repression since World War II. The analysis includes sustained episodes in which the state or its agents impose on a communal or political group "conditions of life calculated to bring about its physical destruction in whole or part." The researcher develops and uses a typology which distinguishes between two categories of genocide (in which the victim groups are defined primarily in terms of communal characteristics) and four types of politicide (in which victim groups are defined in terms of their political status or opposition to the

state). Forty-four episodes meet the operational guidelines developed here. Analysis of their properties and distribution shows that they occurred in all world regions, but with relatively few European and Latin American cases. Two or more began in each five-year period after 1945, with some clustering in the period of African decolonization; their median duration was five years. Aggregate fatalities were between seven and 16 million people, at least as many who died in all international and civil wars in the period.

## The Bundeswehr and Arms Control

Researcher: Associate Professor Gale A. Mattox

This research is part of a project sponsored by the American Institute for Contemporary German Studies of Johns Hopkins University, and is designed to promote greater interest in West German security policy. A binational committee assigned chapters to various American authors, with

German counterparts as reviewers. The final product will review the history of the Bundeswehr and address a number of current issues in German defense policy, including arms control. The author presented the results of her research to a two-day conference in October 1987.

## POLITICAL SCIENCE

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### **The United States and The European Pillar**

Researcher: Associate Professor Gale A. Mattox

As the United States discusses the withdrawal of nuclear weapons from Europe, and sporadic comments by U.S. public officials are made about the need to withdraw conventional forces from the continent, the West Europeans are looking more closely at their options to secure the defense of Europe in a possible future without as large an American presence.

This issue was one of the topics for discussion in a conference held in England at the University of

Newcastle-on-the-Tyne by the British Fulbright Association and the Royal Institute for International Affairs in December 1987. The research was presented at the conference, and all the lectures given during the conference have now been submitted formally and compiled in a manuscript for publication in 1989 by the University of Manchester.

### **Major Issues in NATO for The European Allies**

Researcher: Associate Professor Gale A. Mattox

The research for this project resulted in a chapter reviewing the status of the major security issues in U.S. relations with its European allies. It is part of a more extensive study of U.S. defense issues and concerns directed by Donald E. Snow. The manu-

script is completed and will be published in late 1988 as a book by Lexington Books, D. C. Heath Company. It is for use as a university textbook and reader for a course on National Security Policy at the graduate or undergraduate level.

### **Evaluating The Effectiveness of Computer-Aided Interactive Audio-Video Instruction (CAI IAV) for Learning How to Understand Spanish**

Researcher: Associate Professor Helen E. Purkitt

This study is designed to assess the effectiveness of computer-aided interactive audio-video instruction (CAI IAV) for improving listening comprehension in first and second year Spanish. The Language Department at USNA is at the forefront of efforts to exploit this new technology in an effort to improve foreign language instruction. The purpose of this project is to study whether exposure to CAI IAV using authentic, natural language video clips is a more effective method of instruction. The study is based on an experimental design. First and second year Spanish courses for AY 1987/1988, AY 1988/1989, and AY 1989/1990 have been divided into two tracks. Students in the treatment tracks are using CAI IAV lessons to practice listening comprehension. Students in the control tracks are

using audio cassette tapes. A new standardized test designed to measure Spanish listening comprehension proficiency is being used to measure changes over time, in addition to other qualitative and quantitative indicators. By collecting data for two generations of students enrolled in first and second year Spanish, a number of questions related to the effectiveness of this new approach can be assessed. Moreover, since this is one of the first long-term efforts to evaluate the effectiveness of CAI IAV language instruction, the result of this study should be of interest to the general foreign language community. This research was sponsored by the Naval Academy Foreign Language Department.

# Research Course Projects

## The Sendero Luminoso

Researcher: Midshipman 1/C Alberto R. Alberto, USN  
Adviser: Professor G. Pope Atkins

The Sendero Luminoso of Peru, one of the most prominent guerrilla groups in Latin America, has come from being a relatively unknown and even unimportant movement among the Indian peasants of the Andean highlands to a resilient and dedicated threat to the Peruvian democratic regime. This paper analyzes the Sendero Luminoso from several perspectives, including the evolution of its ideology,

consolidation as a viable insurgency group, its apparent lack of external linkages, and its appeal in social and geographic sectoral terms. The researcher also attempts to determine how such an indigenous movement gained so much power, in terms of its own organization and capabilities and of Peruvian national problems.

## The Latin American Debt Crisis

Researcher: Midshipman 1/C Alfred A. Bunge, USN  
Adviser: Professor G. Pope Atkins

Latin Americans face colossal obstacles in alleviating the economic disparity between themselves and the older industrialized economies. The obstacles have come to center on problems of external debt. As presently structured, the debt incurred in the 1960's and 1970's and comprising a payment crisis in the 1980's, will burden Latin Americans for generations to come. At the same time, default by the major creditors could severely damage the global financial system. These realities make the Latin American debt crisis a series of

realities that requires intelligent policy decisions on the part of a large number of actors in order to cope with a worsening situation. This paper traces the evolution of current debt acquisition, identifies the factors that changed satisfactory political economic relationships to a financial crisis, describes the structure of the debt in terms of economic indicators and debtor-creditor political relationships, and analyzes the various proposals that have been set forth for resolution of the problems.

## The Diplomatic Language of Two Chinas

Researcher: Midshipman 1/C William W. Burkhart, USN  
Advisers: Assistant Professor Barbara Harff  
and Professor Daniel T. Y. Lee (Language Studies Department)

This paper reports on the formal diplomatic recognition of the People's Republic of China (PRC) by the international community since the 3 October 1949 inauguration of the Chinese communist government. A content analysis of the diplomatic communiqües, signed between the PRC and nations of the world, is aimed at identifying the Taiwan-related terminology of each communique. The language of the communiqües are analyzed, and

the groups are listed according to the increasing flexibility of the PRC stance as reflected by language addressing the Taiwan question. This analysis attempts to support the conclusion that the Beijing government was eventually forced to moderate its stance on the Taiwan issue so as to pursue further economic, cultural, and military relations consistent with its national and international policy objectives.

## Soviet Global Strategy

Researcher: Midshipman 1/C William W. Burkhart, USN  
Adviser: Associate Professor Arthur R. Rachwald

This research project examined Soviet global strategy in five major theaters of operation: The United States, Western Europe, Eastern Europe, Pacific region, and the Third World countries. The main objective of this study was to evaluate the

transition from the highly ideological Soviet approach that dominated Moscow's diplomatic moves in the 1970's to pragmatic objectives expected to produce long-term strategic advantages formulated by the current Soviet leadership.

## The Question of Battlefield and Tactical Nuclear Weapons

Researcher: Midshipman 1/C Helge F. Carson, USN  
Adviser: Assistant Professor Barbara Harff

The purpose of this research project was to determine what role tactical and battlefield nuclear weapons have played in the defense strategy of the United States and the NATO Alliance. Included in this project was the effect these weapons had on intra-NATO relations.

Through research it was determined that tactical and battlefield nuclear weapons are weapons which, while being a source of conflict in East-West relations, countries are not willing to surrender, because they provide an important source of security for individual countries. This situation generally

dates back to the initial development and deployment of these weapons within the strategy of NATO. Tactical Nuclear Weapons (TECHNIQUES) also ushered in the era of Flexible Response for the Western Alliance, because they provide the first intermediate step between conventional weapons and strategic nuclear weapons. This category of weapons has recently come to the forefront of East-West arms negotiations and will prove to be a difficult subject for both sides.

## The Constitution and The Military: Patterns of Supreme Court Review of Cases Involving The Military

Researcher: Midshipman 1/C Albert E. Dempsey III, USN  
Adviser: Professor John A. Fitzgerald

The researcher found that the overwhelming majority of convictions appealed to the Supreme Court were sustained. Focusing on a first amendment rights cases--speech, petition, assembly, religion--the researcher found that the freedom of expression that would normally prevail in civilian

society failed to do so in the military context. This extreme judicial deference to the military was almost always justified by the Supreme Court in terms of the military's special need to maintain good order and discipline.

## Latin American Narcotraffic: A North-South Crisis

Researcher: Midshipman 1/C Randall V. Doane, USN  
Adviser: Professor G. Pope Atkins

The use of drugs has become a major social problem in the United States. Four of the eight countries that the U.S. State Department has designated "top priority" in its anti-narcotics program are in Latin America; all but one--Mexico--are located in South America. The most significant countries in the drug trade emphasized in this paper are Colombia, Peru, and Bolivia. Clearly, the role of these countries in the narcotrafico is of the utmost importance.

This paper explains several key aspects of the problem. Specifically, the process of narcotraffic in

U.S.-Latin American relations, the domestic problems in Latin America caused by the traffic, and the security concerns over relationships between the traficantes and insurgent groups were investigated. Factors such as the delicate relationship between the United States and Latin American countries, the unique situation of campesinos in the conflict over trafficking, and the presence of significant terrorist groups in the region complicate an already difficult problem.

## Soviet Naval Arms Transfers

Researcher: Midshipman 2/C James P. Edwards, USN  
Adviser: Associate Professor Gale A. Mattox

From 1946-1986 the Soviet Union transferred 1,938 naval vessels abroad to 41 foreign nations, making it the world's largest supplier of naval arms. The study analyzes trends in the transfer of Soviet naval arms to foreign navies, discussing the number, type, quality, and sophistication of the weapons transferred, and analyzing the circumstances under which the transfers were made.

Part I focuses on the weapons which have been transferred. Part II is an analysis of the Soviet naval arms transfer process itself, focusing on the nations and the circumstances under which the Soviets transferred naval arms, in order to determine what political or military benefits the Soviets obtained from the recipient nations.

For purposes of analysis, the researcher sought to establish trends in types of naval arms transfers in five categories of national government-communist states, non-aligned major Third World states, pro-

Soviet socialist states, small pro-Western non-aligned states, and Marxist-Leninists states. Review of available data for arms transferred by each country within each of these categories was undertaken.

The researcher concluded that while political benefits anticipated by the Soviet Union as a result of naval arms transfers have not always been forthcoming, Soviet arms transfers for the purpose of receiving political benefits from the recipient nations could be expected to continue for three reasons: (1) prospects for political gains outweigh the prospects for political losses; (2) successes have placed the Soviet Union in positions of political and military advantage not possible were it not for the arms transfer programs; and (3) arms transfers buttress the military forces of friendly states, allowing the Soviet Union to dictate how these forces will be used in wartime to support Soviet objectives.

## Comparing Multilateral and Bilateral Relations

Researcher: Midshipman 1/C Keith E. Folkerts, USN  
Adviser: Professor Rodney G. Tomlinson

The goal of this research is to determine if foreign nations present the United States with consistent bilateral and multilateral relations. Most people assume that countries which are basically cooperative with the United States on a bilateral level would also be basically cooperative with it on an international level, and similarly, that nations with bilateral relations marked by conflict will also have a greater degree of conflict present in their multilateral relations.

To study the state of bilateral relations, this study shows how a practical application of field theory is

employed by the World Event/Interaction Survey (WEIS) database. Using this database, trends may be recognized and analyzed in the complex web of international relations.

The field of bilateral relations is studied using the United Nations database. By looking at current trends in United Nations voting, it is possible to see to what degree nations agree in their multilateral relations.

## The Fall of White Rule, The Rise of Black Equality: Forces Contributing to The Making and Breaking of Apartheid

Researcher: Midshipman 2/C Kenneth B. Golding, USN  
Adviser: Associate Professor Helen E. Purkitt

This paper covers the origin of Afrikaaner rule in South Africa from 1652 and its dominance through the 1980's. The evolution of opposition through the current period of unrest is also discussed. One conclusion of this paper is that governmental reforms are disguised forms of discriminatory laws. A second conclusion is that as more countries push for economic sanctions, the South African govern-

ment will be forced to reorganize their society or accept the eventual overthrow of apartheid. A third conclusion is that while the United States has played an influential role in South African politics in the past, the United States now has only a few options left to pursue. The concluding section of this paper analyzes some possible solutions to this conflict.

## Defense Budgetary Process and Its Impact on Military Readiness

Researcher: Midshipman 2/C James D. Gonsalves, USN  
Adviser: Associate Professor William R. Bowman (Economics Department)

The objective of the project is to determine how military readiness measures have been affected by the Reagan defense build-up during the 1980's.

Department of Defense annual budget figures are used to identify the rate of growth of spending by selected categories in terms of dollars and adjusted for inflation, and in terms of percentage composition changes over time.

The major findings of the study show that while spending for all selected categories rose significantly under the Reagan administration, the composition

of budget categories shifted away from operations and maintenance to procurement accounts. With the growing costs of new technologically complex weapons systems, and increasing budgets for their effective maintenance and operation, severe constraints are forecast on the overall readiness of our military forces in the near future. This projection will become even more constrained given expected defense budgetary cut-backs to meet Graham-Rudman ceilings imposed by Congress.

## The War Powers Resolution: Its Role in The Formation of American National Policy

Researcher: Midshipman 1/C Maxmillian A. Grant, USN  
Adviser: Professor Stephen E. Frantzich

The War Powers Resolution has been controversial since its enactment over presidential veto in 1973. The key question is whether the War Powers Resolution, as it is currently implemented, contributes positively to delineating the relative responsibilities and powers of the executive and legislative branches of government in the area of war powers.

Original constitutional provisions will show that the Founding Fathers left confusion in this important area. Historical precedents only further confuse the situation. The origins of the War Powers Resolution indicate the intentions of the legislation's principal sponsors and show that its provisions are open to liberal and speculative inter-

pretation. The resolution has not affected the process in any way which could indicate that the consideration of policies is limited in the staffing of those options. Three case studies confirm that no trend exists either toward an increasing importance of the resolution, or a lessening of its importance. The influence of the War Powers Resolution is dependent on the duration American armed forces are exposed to hostilities. In conclusion, it is evident that the War Powers Resolution does not affect the formation of national security policy and does not alleviate the 200-year-old struggle over the power to use the nation's armed forces as an extension of policy.

## Changing U.S. Security Interests in Latin America: A Cognitive Lag in American Foreign Policy

Researcher: Midshipman 2/C Michael K. Harnett, USN  
Adviser: Professor G. Pope Atkins

Traditional or military-related United States security interests in Latin America have declined relative to other United States concerns in the region. Specifically, the Soviet Union's ability and willingness to carry out its foreign policy objectives in Latin America, especially in the Circum-Caribbean sub-region, have declined over the past decade. Increases

ingly, the United States has elevated two old "problems" to the status of items on the "security agenda"--narcotics trafficking and massive migration. This paper defines official United States perceptions of these new non-traditional threats to national security and analyzes evolving policy positions and actions in the face of these dilemmas.

## The Bell Tolls: The Crisis of Communism

Researcher: Midshipman 2/C Kenneth G. Harris, USN  
Adviser: Assistant Professor Robert L. Beckman

This project won the NAFAC research paper award (midshipman division) for 1988. The topic was particularly well suited to the theme of the conference: INTERNATIONAL POLITICS TOWARD THE YEAR 2000: RESOLVING TODAY'S TENSIONS FOR TOMORROW'S PEACE. The research took the approach that the ideology and practice of Communism are incompatible with a healthy economy, and went on to analyze the inevitable breakdown of the "secular religion" of totalitarian communism as currently seen in Perestroika and Glasnost. The paper was

particularly incisive in pointing out dilemmas for General Secretary Gorbachev and for any American president, given the revolutionary implications of economic restructuring within the Soviet Union. The crisis for Communism will have a deep and abiding impact on the West, as the USSR and its satellites relax internal central control. In this sense, in the mind of the researcher, economics is politics: free markets, independent production decisions, personal initiative, and profits all conspire to threaten Communist Party control.

## Examples of Soviet Strategic Foreign Policy: INF, U.S., and The Afghan War

Researcher: Midshipman 1/C Todd W. Hickerson, USN

Adviser: Associate Professor Arthur R. Rachwald

This independent research project had three narrowly defined goals. The first part involved a critical examination of the political and military situation in Europe in the context of a growing demand for conventional forces. Reduction of nuclear deterrence through the International Nuclear Force (INF) negotiations increased Soviet military advantages in Europe. The second part of this study evaluated changing relations between the

superpowers owing to three factors: the danger of war receded, United States policy of containment dwindled, and the Soviets became dissatisfied with imperial missions. The last part of this project presented a case study of the Soviet engagement and disengagement in Afghanistan, and covered political options now available for the United States following the end of the Afghan war.

## Religion in Southeast Asian Government: A Comparative Study

Researcher: Midshipman 1/C Pamela L. Hilton

Adviser: Professor Robert L. Rau

In the sphere of world politics, one ideology slowly becoming more prominent is Islam. An understanding of this religious philosophy is fundamental to an appreciation of the political machinations of Malaysia and Indonesia. For this reason this project treats Islam in these two countries.

The first section of the paper deals with Islam in Southeast Asia. The basic religion is described, with particular attention given to the political system inherent in the belief system. Then, each nation and its political reaction to the Islamic faith are analyzed. Comparison of the two is drawn along

the lines of their racial composition, history of revolts, colonial powers, belief systems, national character, and political freedoms.

Using indicators like the per capita Gross National Product (GNP), life expectancy, infant mortality rate and the like, it is possible to compare the effects of the political decisions in accommodating Islam. Such comparisons resulted in the conclusion that due to the forces of history, Indonesia has more pressure to follow Islamic tenets, often to her detriment.

## The Development of the KGB

Researcher: Midshipman 1/C Lindsay T. Kough, USN

Adviser: Professor Charles L. Cochran

The purpose was to examine the origins and factors in the evolution of Russian intelligence organizations and activities from the Czars through the revolution and modern issues. The methodology was through library research, with some interviews.

The Russian culture has had an enormous impact on these organizations, forcing more stability than change on the style, methods, approaches, and ethos of Soviet intelligence agencies.

## **U.S.-Soviet Crisis Prevention in The Third World**

Researcher: Midshipman 1/C William T. Lennard, USN  
Adviser: Associate Professor Gale A. Mattox

The advent of detente in the 1960-1970's necessitated a variety of agreements between the United States and Soviet Union. The objective of these agreements was to avoid rivalry and competition in the Third World to prevent crises from occurring. Due to misunderstandings or misinterpretations, this crisis prevention strategy was not successful. The United States and the Soviet Union were repeatedly embroiled in confrontations. The researcher conducted an analysis of the origin and execution of crisis prevention as a mutually agreed-upon policy during an approximately fifteen-year period. Drawing on the experiences of the Middle East and Angola, he reviewed the factors underlying the failure of the theory of crisis prevention in practice.

The researcher concluded that for crisis prevention to be successful, two criteria must be met. First, agreements between the superpowers must be specific enough that there is little opportunity for differing interpretations of when and how agreed principles should be executed. A second criteria for successful crisis prevention was deemed to be effective enforcement. This, the researcher conceded, is a more difficult obstacle, and one cannot hope for much more than an atmosphere of cooperation that would lend itself to self-enforcement.

## **U.S. Strategy, NATO, and The Out-Of-Area Problem: Maritime and Continental Options**

Researcher: Midshipman 2/C Paul J. Ling III, USN  
Adviser: Associate Professor Gale A. Mattox

The future direction of American military strategy is a controversial issue. Advocates of "continental" and "maritime" military strategies are engaged in a vigorous debate over the future of conventional military strategy. This paper examines the strategic options facing the United States with the approach of the twenty-first century.

Four specific strategic questions are addressed: First, should the United States adopt a continental or maritime military strategy? Second, how does the United States commitment to the North Atlantic Treaty Organization (NATO) fit into American and

alliance military strategy? Third, how can the United States best protect Western interests in an increasingly important but unstable Third World? Finally, what balance should be struck between commitments to NATO Europe and the "out-of-area" threat in the Third World?

The paper concludes with specific recommendations for American national security policy, military strategy, and force structure to provide more flexible military options for the United States and the Western Alliance in dealing with both the Warsaw Pact and out-of-area threats.

## The Potsdam Conference: A Shift in Global Power

Researcher: Midshipman 1/C Mark P. Lotze, USN  
Adviser: Associate Professor Gale A. Mattox

The Potsdam Conference involving Churchill, Stalin, Truman, and Attlee marked a pivotal change in the relationships among the allies. Using the proceedings of the conference and memoirs of the principal actors, this researcher examines the different goals the leaders brought to Potsdam, where they entered into the negotiations which would shape the postwar world. The major thesis of the study contends that political changes in the United States and Great Britain, preceding and during the conference, weakened the West's overall policy and continuity of action with the Soviets.

The researcher concludes that this is an area of weakness which can exist in all freely elected

democracies, and that democratic governments involved in future negotiations could draw important lessons from the postwar experience. After thorough review of the conference and the mistakes of the West, he offers several suggestions to negotiators: be patient to extremes; always ask for more than you expect to get and assume your counterpart will do the same; never give up an advantage without just reason or a reciprocal return; and do not compromise for the sole purpose of achieving something if it is not compatible with your objectives.

## When Form is Substance: Congressional Response to The Strategic Homeporting Plan

Researcher: Midshipman 1/C Michael J. Ma, USN  
Adviser: Professor Stephen E. Frantzich

The strategic homeporting plan attempts to meet both the strategic and political needs of the Navy. Through analysis of the process of the formation of the plan and the factors that affected the realization of strategy, interesting conclusions may be drawn about the nature of national security decisions. Although the Navy's purpose rests outside of the political arena, closer examination of the forces behind homeporting provides evidence to support very real political considerations in the implementation of strategy.

The homeporting plan provided for the simultaneous realization of two basic goals: first, strategic benefits were to be gained from the strategic dispersion created by more homeports. At the same time, though, this plan allowed for expansion of the base of congressional support for the larger Navy. Although the strategic rationale for the plan was repeatedly used throughout the congressional process, the political realities of the program contributed to the formation of the final policy.

## The Armed Forces of The Philippines As A Source of Instability

Researcher: Midshipman 1/C Maximo Q. Mejia, Jr., USN  
Adviser: Professor Robert L. Rau

The paper examines how the Armed Forces of the Philippines (AFP), given its armed capability and the Aquino administration's still precarious situation, is still demanding an even more active role in government. The coup attempt on 28 August 1987 attests to this fact. That particular event has shown that the AFP (or at least a number of its men) believes that it has the duty to assert itself whenever there is a perception that the civilian

government is not in control. It is almost always dangerous to have a military that is capable and willing to effect change in government based on the former's "perceptions." In this sense the AFP has become, instead of a force for reform and progress, a source of instability.

Sources used for the research include newspaper articles, journal articles, books, and interviews with different Filipino and American officers.

## A Palestinian Homeland: Is It Possible?

Researcher: Midshipman 2/C Mark V. Metzger, USN  
Adviser: Assistant Professor Barbara Harff

This paper deals with the Arab-Israeli conflict. The Palestinians are using armed force, such as terrorism, to gain a homeland in present-day Israel. But its use has yet to force the military powerhouse of Israel to the negotiating table. The PLO leadership was dealt a major blow when forced to leave Lebanon in 1982. The Palestinians have tried to obtain Arab support, but Arab nationalism has not proven to be an effective aid for their cause. Success of the Palestinians in achieving a homeland currently rests in the hands of its own people, primarily those closest to the fighting, those in the occupied territories.

This paper utilizes the previous information as a means of understanding the problem and to discuss a possible solution. Some of the primary peace proposals are presented. Also discussed are United States foreign policy concerning the conflict during the Reagan Administration and the progress of Secretary of State Schultz's peace initiative. In the researcher's opinion, this paper offers a solution which will be acceptable to the majority of Israelis and Palestinians.

## Superpower Competition in The Third World: The Struggle for Caribbean Influence

Researcher: Midshipman 2/C Kathleen J. Monaghan, USN  
Adviser: Professor G. Pope Atkins

The Soviet Union's alignment with the Cuban revolutionary government in the early 1960's and its support of the Nicaraguan revolutionary government after 1979 have presented major challenges to the primacy of United States influence in the Caribbean region and provoked a variety of responses and policy actions. This paper is an analysis of each superpower's policies in the Caribbean area. It

seeks to determine their different strategic perceptions of the area and how this translates into definition of interests, choice of instruments, calculations of acceptable cost and risk, and, especially, the factors impinging on their capabilities not only to realize objectives but to choose policy instruments freely.

## The Nonaligned Movement: A Criticism of Inaction

Researcher: Midshipman 2/C Jeanine L. Noser, USN  
Adviser: Associate Professor Gale A. Mattox

In its twenty-eight year existence, the Nonaligned Movement (NAM) has not proved to be a viable diplomatic strategy for most of its members. Despite numerous NAM attempts to stem the use of force, the Sino-Indian, Arab-Israeli, Vietnamese-Kampuchean, Soviet-Afghan, and Iranian-Iraqi conflicts continue unmitigated. Thus, the cleavage between nonaligned objectives and results widens. "Nonalignment" becomes more of a slogan than an operational phenomenon.

The researcher found that external and internal obstacles stifle NAM progress. Ex-colonies, like India with its severe economic problems, are caught between East-West dependence. Increasing nuclear capabilities tempt nonaligned nations to reject NAM ideology in favor of national security. The effec-

tiveness of the NAM is limited also by the organizational structure of the United Nations, which accords the superpowers more influence. Most damaging to the movement's credibility are the regional conflicts between nonaligned nations such as Iran and Iraq.

On the basis of analysis and review of the NAM generally and two specific case studies, the researcher concluded that criticism of NAM inaction does not necessarily warrant disbanding the nonaligned group. To the contrary, institutionalized nonalignment has a psychological importance if not an operational capability. Because NAM provides a platform for Third World leaders, nonaligned leaders can have a collective impact on global thinking.

## Soviet Foreign Policy Goals in The Persian Gulf

Researcher: Midshipman 1/C Sean F. Reid, USN  
Adviser: Associate Professor Arthur Rachwald

This research project on Soviet foreign policy goals in the Persian Gulf was organized in three distinct parts. Historical survey of the Russian state's intentions and policies in the Gulf, since Peter the Great introduced "drive to the sea" to Admiral Gorshkov's "blue water Navy," was included in the first part. The second part of this study examined

modern Soviet policies in the Gulf, with special attention to the current political tasks performed by the Soviet fleet. The last section of this work inquired into the alternative future political and military objectives of the USSR in the Gulf and the methods most likely to be deployed by the Soviet navy.

## The Reunification of Korea

Researcher: Midshipman 1/C Timothy M. Salmon, USN  
Adviser: Professor Robert L. Rau

Korea is of great strategic importance. Caught among China, Japan, the Soviet Union, and the United States, this divided nation continues to be polarized for various purposes. The superpowers would very much like to tap into Korea's rising economic and military strength by influencing the political changes which are taking place both in North and South Korea.

A base study of the Korean history and division is essential to understand the nation's political atmosphere. In particular, the reunification effort

and its effects on the power struggle must be considered. Findings included an analysis of the "Prisoner's Dilemma" which currently keeps the Democratic People's Republic of Korea (DPRK) and Republic of Korea (ROK) governments from conducting peaceful negotiations. Additionally, it seems doubtful that the superpowers would allow a united and powerful Korea to upset the status-quo, even if the ethnocentric nation could find the will to do so.

## The Effects of Wealth and Other Variables on The Content of Campaign Funds in The U.S. House of Representatives

Researcher: Midshipman 2/C Robert B. Samuels, USN  
Adviser: Professor Stephen E. Frantzich

The research dealt with several questions concerning the make-up of campaign funds for congressmen. A major question was the effect that the wealth of an individual representative has on the amount of money that he receives from political action committees. Wealth as a variable was also checked against the variables of individual contributions, receipts from the candidate's party, and the candidate's own personal contributions. The data analyzed came from the 1986 election figures

published in *The Political Almanac* and *The Almanac of American Politics*. The information on the net worth of congressmen came from the financial disclosures each member is required to file yearly. There were several indications that strong-to-moderate relationships that included net worth exist. The study could serve as a good foundation for further research on any one of the relationships that were explored.

LOFSTROM, William L., Visiting Professor, *La presidencia de sucre en Bolivia*. Caracar, 1987  
Academia Nacional de Historia.

In the first quarter of the nineteenth-century, ten sovereign South American states were carved from two vast European empires in an unprecedented process of nation building. While much attention has been focused on the political and military aspects of the Latin American independence movements, there has been little scholarly interest in the creation and evolution of social and economic institutions which accompanied political autonomy, despite their critical importance to the subsequent development of the independent nations of South America.

The Republic of Bolivia, created in 1825 within the jurisdiction of the colonial Audiencia de Charcas, in Upper Peru, participated in this process of accelerated political, economic, and social transformation. The reforms which were undertaken in the first years of Bolivian independence were both a reflection of similar measures enacted earlier in other Latin American states, and of the broader European movements of eighteenth-century liberalism and the enlightenment. They included radical changes in attitudes about the participation of the individual in government, the organization of the state, its role in the regulation and promotion of the economy, its responsibilities in the fields of education and social welfare, and the role of the Church within this changing society.

This monograph analyses several aspects of the experiment in political, social, and economic change which took place between 1825 and 1828, and demonstrates why social and economic change was largely unsuccessful in Bolivia. Although reform failed in Upper Peru, as it did elsewhere, the Bolivian experience provides a heretofore neglected case history of reform efforts which may be contrasted with similar developments in other Latin American nations.

Even though the promise of social and economic transformation made by Sucre was largely unkept, this period can by no means be discounted as unimportant to subsequent Bolivian history. Reformist and innovative in nature, it was the cradle of many of Bolivia's most important national institutions and it consolidated the political declaration of independence made in 1825, preserving Bolivia as an independent state in the midst of considerable hostility. Finally, the reforms attempted during the

Sucre administration provided both the inspiration and the guide for a number of important, although less-ambitious, measures enacted by subsequent governments.

MATTOX, Gale A., Associate Professor, co-editor, *Evolving European Defense Policies*. Lexington: Lexington Books (D.C. Heath and Company), 1987.

The book examines the national defense agendas of the United Kingdom, France, West Germany, the Netherlands, Italy, and Norway. In each case, the political/economic context and intradefense trade-offs between men and materials, and between operations and capital investments are addressed. In addition, the evolution of a number of significant policies is assessed from a broader cross-European perspective, including the balance between conventional and nuclear weaponry, burden-sharing, technical cooperation, arms control, out-of-area challenges, and the prospects of European sub-alliances within the overall NATO structure.

MATTOX, Gale A., Associate Professor, "Suggested Readings," *Politics in Perspective: A Symposium on Security Studies*, 14, 3 (Spring 1987), 146.

This bibliography is an annotated selection of books for an undergraduate course in National Security Policy.

MATTOX, Gale A., Associate Professor, "Western Europe and Arms Control: An Overview," *Nuclear and Conventional Forces in Europe: Implications for Arms Control and Security*, ed. W. Thomas Wander. Washington DC: Program on Science, Arms Control, and National Security of the American Association for the Advancement of Science, pp. 117-130.

The chapter addresses the major substantive issues confronted by the West Europeans in discussions dealing with nuclear and conventional force reductions. It draws attention to the potentially disturbing consequences for the concept of extended deterrence and the current framework for Atlantic defense.

The book was prepared for the 1987 annual meeting of the American Association for the Advancement of Science.

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## Kampuchea and Vietnam

Researcher: Midshipman 2/C Rita G. Tauber, USN  
Adviser: Professor Robert L. Rau

This research involved the ongoing conflict in Kampuchea between the occupying Vietnamese forces and the forces of three resistance movements. The goal was to identify the sources of this conflict and to examine possible resolutions.

The first part of the research involved the historical aspects for conflict in Indochina. Next the local actors in the conflict, the Khmer Rouge, the ANS, the KPNLF, and the present government held up by the Vietnamese government were examined. Then the regional actors, specifically the Association

of Southeast Asian Nations, and the role that these nations have played in the conflict, were examined. This included the special interests of Thailand, because of its proximity to, and direct involvement in the conflict. The final section of the paper examined the interests of the three large powers involved in the area, the People's Republic of China, the Soviet Union, and the United States. Each of these nations has taken a stance on the issue and all give aid to one of the forces involved.

## The U.S./Japanese Relationship

Researcher: Midshipman 3/C Jeffrey P. Varanini, USN  
Adviser: Professor Robert L. Rau

The purpose of this research was to examine the trade relationship between the United States and Japan. Specifically, it focuses on the military hardware trade, now becoming a larger part of American efforts to reduce the trade deficit with the Japanese. The researcher shows how this trend had evolved since post World War II.

This paper was divided into five sections, titled "Introduction," "the Relationship," "the Problem," "Implications," and "Future Prospects." The rela-

tionship was examined in detail, with all important events during this period. After this, the researcher explained the connection between these two issues, using the case study of the FSX, an experimental Japanese fighter. An analysis of the implications for the United States, Japan, and the mutual relationship followed. Finally, an assessment was made as to whether this was a positive development for both countries.

## Determinants of Congressional Voting Behavior on Defense Issues

Researcher: Midshipman 1/C Travis D. Zach, USN  
Adviser: Professor Stephen E. Frantzich

Congressional voting behavior on military/defense issues may be influenced by a variety of variables. Research shows that members of Congress who are military veterans are more likely to vote "pro-defense" than members who are not veterans, and military payrolls and industry within individual states influence the defense voting behavior of those

states' Congressional representatives. Political party and ideology are also considered to be significant influences. In addition, there are numerous other individual variables which may affect Congressional voting behavior. The military has a considerable stake in what that behavior is in the current atmosphere of austerity.

## POLITICAL SCIENCE

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PURKITT, Helen E., Associate Professor, co-author, "Computers in Political Science," *Social Science Microcomputer Review*, 5:4 (Winter 1987), 485-505.

The article surveys recent trends in using computers in the classroom and for research in Political Science. Recent software and hardware developments in using the computer as an access tool, for bibliographic searches, to access raw data, for "real time" monitoring of political trends, for computer conferencing, data analysis, simulations, and the construction of expert systems are discussed. The article concludes with some general insights about the promises and pitfalls of using computers to study politics. A list of publishers for all software discussed in the article is included as an appendix.

PURKITT, Helen E., Associate Professor, co-author, "Opening the 'Black Box': Cognitive Processing and Optimal Choice in Foreign Policy Decision Making," *New Directions in the Study of Foreign Policy*, eds. C.F. Hermann, C.W. Kegley, and J.N. Rosenau. Boston: Allen Unwin, 1987, pp. 203-220.

This chapter discusses past efforts to develop a comparative theory of foreign policy decision making and outlines a new theoretical approach for studying political decision making based on recent insights from information processing and game theoretical research. Evidence supporting a basic model of political choosers viewed as 'limited information processors' is reviewed and related to current research efforts. The chapter also illustrates how this new paradigm can be combined with game theory to increase our understanding of political processes and to develop decision-aiding tools.



## Presentations

ATKINS, G. Pope, Professor, "Problems of Legitimacy in Argentina's Return to Democracy," Conference on Argentina, Washington, DC, 20 February 1988.

BECKMAN, Robert L., Assistant Professor, "The Nuclear Fuel Cycle and Arms Control," American Association for the Advancement of Science, Washington, DC, 7 June 1988.

BREEDEN, George L., Commander, USN, "Maritime Strategy," "Maryland Line" Chapter of Daughters of American Revolution, Monckton, Maryland, 9 February 1988.

COCHRAN, Charles L., Professor, "Second Thoughts on the Creation of Discipline of Conflict," Center for Strategic and International Studies, Washington, DC, 27 March 1988.

FITZGERALD, John A., Professor, "Curriculum Change at the Naval Academy, 1960-1985," Bi-annual Conference, Intra-University Seminar on Armed Forces and Society, Chicago, Illinois, 8-10 October 1987.

FITZGERALD, John A., Professor, Roger D. LITTLE, Professor (Economics), and Ray F. TURNER, Lieutenant Commander, USNR (Economics), Military Veterans and Their Voting on Defense Issues in the 98th Congress," Bi-annual Conference, Intra-University Seminar on Armed Forces and Society, Chicago, Illinois, 8-10 October 1987.

FRANTZICH, Stephen E., Professor, "The Implications of Congressional Computerization," German Bundestag, Bonn, Germany, 20 June 1987.

FRANTZICH, Stephen E., Professor, "C-SPAN in the Classroom: A Window on the Political Process," Benton Foundation Seminar for College Faculty, Washington, DC, 21 July 1987.

FRANTZICH, Stephen E., Professor, "Separation of Powers in the American Contest," Congressional Management Foundation Seminar for Latin American Parliamentarians, Washington, DC, 4 September 1987.

FRANTZICH, Stephen E., Professor, "Public Access to Congressional Information in the Technological Age," U.S. Congress, Office of Technology Assessment (testimony before oversight panel), Washington, DC, 29 January 1988.

FRANTZICH, Stephen E., Professor, "C-SPAN in the Classroom," New England Political Science Association, Boston, Massachusetts, 18 April 1988.

FRANTZICH, Stephen E., Professor, "Separation of Powers, Federalism, and American Politics," USIA/Congressional Management Foundation Seminar for Central American Parliamentarians, Washington, DC, 24 May 1988.

HARFF, Barbara, Assistant Professor, Rapporteur of a Session on Cambodia, Conference on Recognition and Denial of Genocide and Mass Killing in the Twentieth Century, City University of New York, New York, 13 November 1987.

HARFF, Barbara, Assistant Professor, Chair, Roundtable on Comparative Inquiry on Genocides and Politicides--Approaches and Objectives, International Studies Association Meeting, St. Louis, Missouri, 30 March - 2 April 1988.

HARFF, Barbara, Assistant Professor, Panelist on Roundtable on Comparative Inquiry on Genocides and Politicides--Current Research, International Studies Association Meeting, St. Louis, Missouri, 30 March - 2 April 1988.

KRUSE, John E., Captain, USMC, "Ramifications of U.S. Security Policy in the Persian Gulf," Southwest Social Science Association Conference, Houston, Texas, 24 March 1988.

LOFSTROM, William L., Visiting Professor, "Faces and Places in the Andes; A Glimpse at One Corner of Indo-America," International Club of America, Annapolis, Maryland, 4 May 1988.

MATTOX, Gale A., Associate Professor, "Europe after the Dismantling of Intermediate-Range Nuclear Forces," Annual Meeting of the International Studies Association, St. Louis, Missouri, 2 April 1988.

MATTOX, Gale A., Associate Professor, Panel Chair, "Future of German Defense Policy," Annual Meeting of Section on Military Studies, Atlanta, Georgia, 25 September 1988.

MATTOX, Gale A., Associate Professor, "Constitutionality of Strategic Planning," The Constitution and National Defense, National War College, Washington, DC, 19 November 1987.

## POLITICAL SCIENCE

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MATTOX, Gale A., Associate Professor, Panel, "A Pessimistic View of U.S./West German Major National Security Issues," Center for European Studies, Harvard University, Boston, Massachusetts, 24 October 1987.

MATTOX, Gale A., Associate Professor, Chair, "Conventional Forces Seminar," American Academy of Arts and Sciences, Washington, DC, 12 December 1987.

MATTOX, Gale A., Associate Professor, "NATO: Major Issues Today," Naval Reserve SACLANT Det 106, Washington, DC, 14 May 1988.

PURKITT, Helen E., Associate Professor, "An Experimental Study of Cognitive Processes and Information in Political Problem Solving," Eleventh Annual Conference on Subjective Probability, Utility, and Decision Making, Cambridge, England, 23-27 August 1987.

PURKITT, Helen E., Associate Professor, "Using Microcomputers to Teach Political Science Methods," 1987 American Political Science Association Annual Meeting, Chicago, Illinois, 3 September 1987.



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